# Corca Dhuibhne

IQUA

Treoir Allamuigh Uimhir 9

Field Guide No. 9

# CORCA DHUIBHNE

le / by

W.P. Warren

le dréachtaí ó
with contributions from

C.A. Lewis
I.M. Quinn
P. Woodman
R. Devoy
J. Shaw
J.D. Orford
R.W.G. Carter

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## CONTRIBUTORS


| | | |
|---|---|---|
| Bill Carter | (BC) | Environmental Science, University of Ulster, Coleraine. |
| Robert Devoy | (RD) | Department of Geography, University College, Cork. |
| Colin A. Lewis | (CAL) | Department of Geography, University College, Dublin. |
| Julian D. Orford | (JO) | Department of Geography, The Queen's University, Belfast. |
| Irene M. Quinn | (IMQ) | Laurleen, Stillorgan, Co. Dublin. |
| John Shaw | (JS) | Atlantic Geoscience Centre, Geological Survey of Canada, Nova Scotia. |
| William P. Warren | (WPW) | Quaternary and Geotechnical Section, Geological Survey of Ireland. |
| Peter Woodman | (PW) | Department of Archaeology, University College, Cork. |




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## INTRODUCTION

This guide should be used in conjunction with Ordnance Survey sheet 20, 1:126,720.

Corca Dhuibhne (Corkaquiney of the Ordnance Survey maps) is the barony that is very nearly conterminous with the most northerly of the three main peninsulas of southwest Ireland. Increasingly it is being subjected to that onomastic barbarism, the Dingle peninsula, a title that has not pedigree, history nor euphony to recommend it. Only the eastern end of the peninsula from Curraheen on the north, Cathair Conroi on the mountain ridge and Aughils in the south, lies outside Corca Dhuibhne in the barony of Trughanacmy.

With regard to both bedrock geology and topography there are striking differences between Corca Dhuibhne and the peninsulas to the south, Iveragh and Beara. The bedrock geology is more varied, with a variety of lithologies extending in age from the Silurian to Carboniferous, and the topography is less rugged with less obvious evidence of intense glacial activity. It contains an immensely rich and diverse archaeological heritage (Cuppage _et al_., 1986) and has experienced a varied and interesting history. It contains the largest of the Munster Gaeltachtaí and produced some of the most important modern Gaelic writers, and it was the birthplace and home of the seventeenth century gaelic poet Piaras Feiritéar. Its chief town, Dingle, was an important medieval port which had important trading links with France and Spain.

It was in Corca Dhuibhne at Fán (Fahan) that Patrick Ganley discovered the use of crossbedding as an indicator of way-up in sedimentary rocks and it was here also, at Lough Doon (or Peddlers Lake), that a cirque basin and its moraine were first described in the Irish scientific literature (Ball, 1849). The area has a rich flora and fauna that includes many of the so-called Lusitanian species that are common in southwest Ireland.

This guide looks at aspects of the Quaternary geology (we may include archaeological remains as trace fossils) of Corca Dhuibhne. It is not exhaustive as it is designed around a two-day field excursion (Fig. 1); but it highlights the most important aspects of

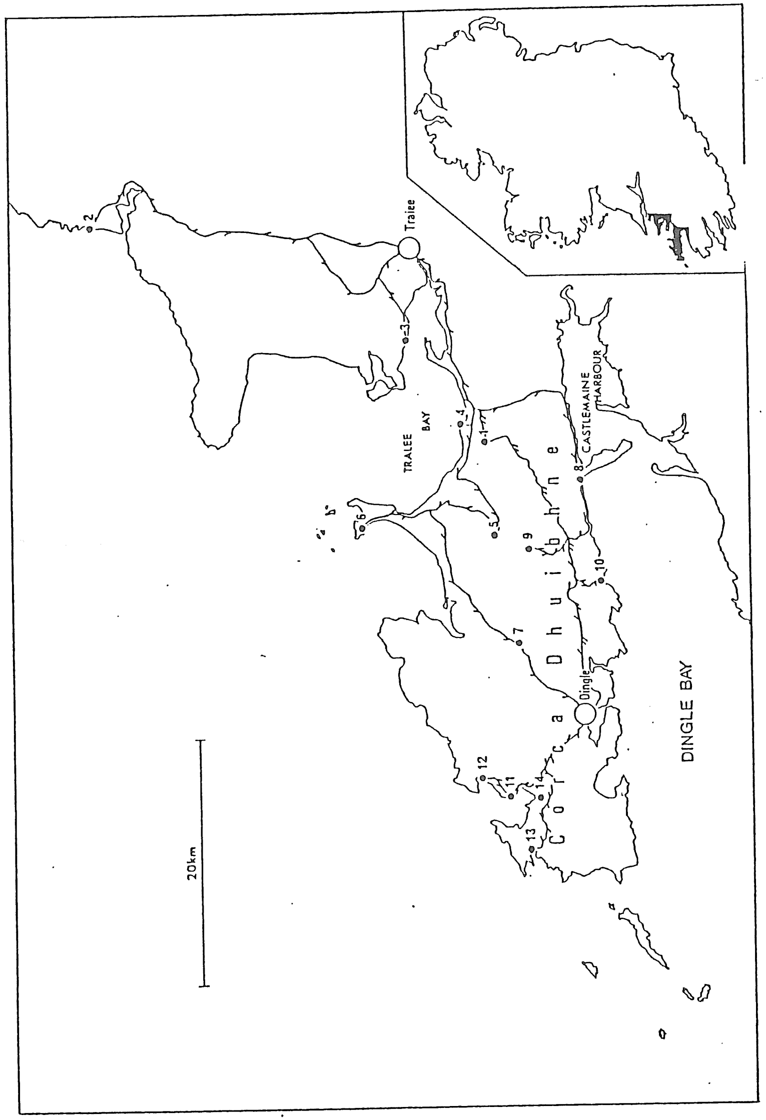



Fig. 1. Localities of sites described in the guide.



the Quaternary record here and illustrates the fruits of ongoing work.

The Upper Carboniferious sediments that occur further north both in Kerry and Clare do not outcrop in Corca Dhuibhine. But they will be encountered in the Quaternary deposits of Ballybunnion, Fenit and on the north coast of Corca Dhuibhne.

## BEDROCK GEOLOGY

The bedrock geology of Corca Dhuibhne has been hotly debated for more than a century. The stratigraphy is still controversial but the broad model followed here is that of Horne (1974), which is the most complete modern interpretation of the bedrock geology of the area (Fig. 2).

The oldest rocks of the area are the Silurian marine mudstones, siltstones and sandstones and volcanic tuffs. They occur in two major inliers and three minor ones. They are the Dunquinn Inlier and the Annascaul Inlier, and the smaller Bulls Head, Derrymore Glen and Caheracruttera Inliers. All belong to the Dunquinn Group. These are succeeded unconformably by the grey, green and red sandstones, shales and conglomerates of the Dingle Group, the Dingle Beds of the older literature. This is the most extensive group in Corca Dhuibhne; it underlies most of the western part and central parts of the peninsula and is late Silurian to early Devonian in age.

The Caherbla Group succeeds these rocks unconformably and is composed of pale red sandstones and a very distinctive conglomerate, the Inch Conglomerate Formation. The angular mainly metamorphic phenoclasts of schists and gneisses (often granitic) which dominate it are often coarse and micaceous and make it an easily identified tracer erratic. It also contains fragments of granite, sandstone, shale, chert and jasper. This group extends in a band some 2-4km wide from Minard to Sliabh Mis. The Caherbla Group is Devonian in age.

The Glengarriff Harbour Group comprises red sandstones and quartz conglomerates. It outcrops on the northern, eastern and southern of banks of Sliabh Mis and on the northern flank of the

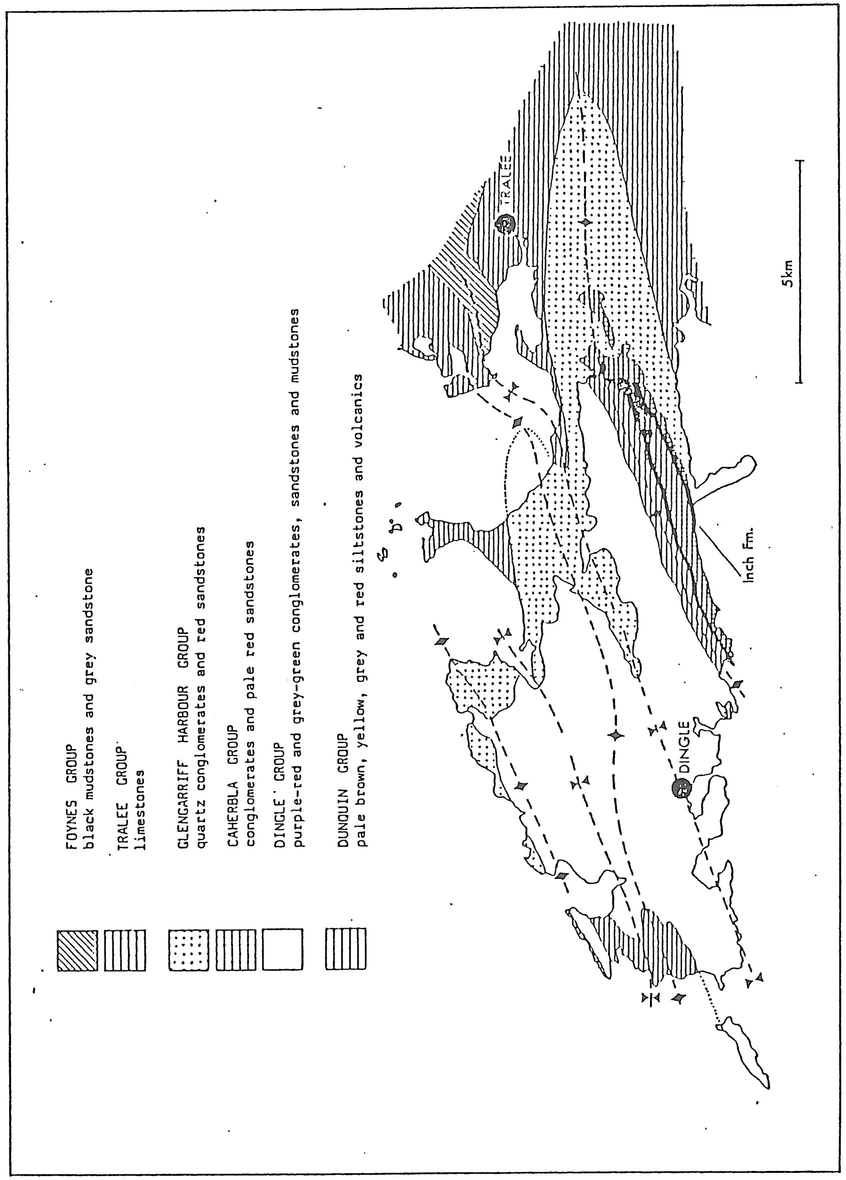



Fig. 2. Outline of the bedrock geology of Corca Dhuibhne (after Horne, 1975).



hills of central Corca Dhuibhne and suceeds, unconformably, the Caherbla Group. The Glengariff Harbour Group marks the top of the Devonian rocks here but the contact between the top of this group and the overlying Lower Carboniferous of limestone is not seen.

Carboniferous limestone outcrops on the lower flanks of the Sliabh Mis and particularly along the north coast and to the north of Castlegregory.

The Upper Carboniferious sediments that occur further north both in Kerry and Clare do not outcrop in Corca Dhuibhine. But they will be encountered in the Quaternary deposits of Ballybunnion, Fenit and on the north coast of Corca Dhuibhne.

Although Corca Dhuibhne might be structurally regarded as a large anticlinorium the structural grain running northeast-southwest is generally diagonal to the east-west alignment of the peninsula and it encompases a series of three major anticlines which pick out the three main mountain groups Sliabh Mis, Bennoskee and Brandon.

## QUATERNARY GEOLOGY

Evidence of former glaciation has been recognised in Corca Dhuibhne since the early 1840's following Agassiz's visit to Ireland late in 1840. In 1842 C.W. Hamilton read a paper to the Geological Society of Dublin in which he referred to ice moulded and scratched rocks in the vicinity of Dingle. In 1849 J. Ball's lucid description of Lough Doon as a cirque basin was published and in 1852 Rowan identified limestone erratics in a tributary stream of the Finglas River. Jukes and Du Noyer (1863) described some of the Quaternary deposits of the area in outline. They recognised evidence for extensive local glaciation and suggested that Inch Conglomerate erratics had been transported from the southern side of the peninsula to the northern side. They attributed many of the glacial features on the northern side of the peninsula to floating ice. In the present century Charlesworth (1928) suggested the area was glaciated by local glaciers of very limited extent. Farrington (1947) and Proudfoot (1954) suggested slight encroachment of coastal areas by extraneous ice. King and Gage (1961) recognised the influence of much more extensive extraneous ice and Orme et al.

(1964) suggested, cartographically, that the peninsula was affected by ice from the south and ice from the north. Bryant (1966) perceived that most of Corca Dhuibhne had been glaciated and Mitchell (1970) suggested that ice from the north pushed against the northern flanks of Sliabh Mis to an altitude of about 160m and that a later piedmont glacier fed from the Owencashla valley extended across Tralee Bay to Fenit. Following Farrington (1947), he reckoned that ice had not passed over Sliabh Mis.

Lewis (1974) presented a comprehensive view of the glaciations of Corca Dhuibhne. He concluded that ice from the north and east passed through some of the cols of Sliabh Mis and extended westward along Castlemaine Harbour and that ice pushed on shore at Smerwick Harbour. This was followed by an expansion of local ice that extended beyond the north coast. Lewis (1974) also suggested that ice from the south pushed against the southern flanks of the peninsula. All of these events were ascribed to a penultimate glaciation, which he termed the Greater Dingle Glaciation.

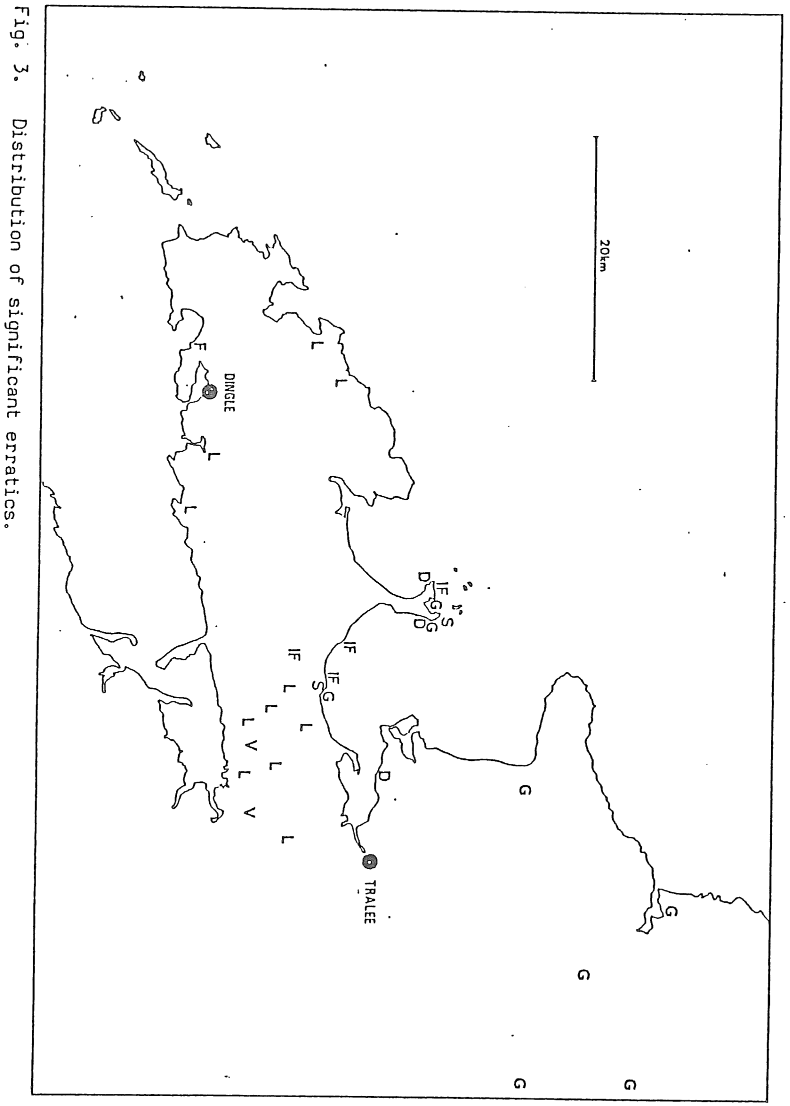
Lewis also concluded that during the event he termed the Lesser Dingle Glaciation, separated from the Greater Dingle Glaciation by a "presumed interglacial", glaciers were entirely locally based and nowhere expanded significantly beyond the present coast (see Figure 9 below).

In the course of a Geological Survey mapping programme in southwest Ireland, using standard geological lithostratigraphical mapping techniques, I find I am in some disagreement with Lewis' (1974) interpretation.

At Camp (site 3 below) on the northern side of the peninsula the Camp Till Formation underlies the Tonakilly Till Formation. The Camp Formation is characterised by erratics of northern or northeastern provenance and testifies to ice movement from the north or northeast. The overlying Tonakilly Formation is characterised by erratics of generally southern provenance and testifies to an ice movement from the south, southeast or southwest. The Tonakilly Formation contains Inch Conglomerate Formation erratics between Camp and Fahamore. And whether these erratics come from the main Inch Conglomerate outcrops south of the watershed, the small outcrops at the head of Derrymore Glen or Com a' Stábla at the head of the



Fig. 3. Distribution of significant erratics.



Finglas valley they confirm a southeast-northwest ice movement associated with the Tonakilly Till Formation in this area.

Thus in the area of Camp there is a clear indication of an ice movement from the north followed by one from the south. At Kilshannig north of Castlegregory a very similar sequence is seen. The Camp Till Formation is overlain by Devonian sandstone dominated till probably the Tonakilly Formation. The occurrence of Inch Conglomerate in the Tonakilly Till Formation at Fahamore, near Kilshannig confirms an ice movement from the south or southeast and excludes a source in the Owenmore valley to the southwest.

The general distribution of erratics at the eastern end of Corca Dhuibhne, both in tills and at the surface, is instructive (Fig. 3). Limestone erratics are common in the Finglas valley both on the surface and in a lower till facies which underlies a till of dominantly local lithologies. These have been traced to 150m on the northern side of Sliabh Mis. On the northern side of the watershed of the peninsula Inch Conglomerate erratics are found scattered through Gleann na nGealt and must almost certainly have come from the southern side of the watershed. On the southern side, silicified limestone can be traced from sea level to about 520m at Glenbrack mountain and it litters the col between Knockbrack and Caherbla. In addition, felsite erratics, almost certainly from the Killarney area, have been found to an altitude of about 150m on the southern slopes of Sliabh Mis.

On the other hand, the distinctive cherty shale of the Clare Shale Formation has not been reported any further south than the northern coastal area of the peninsula. And the Silurian "erratics" at Caherrcauttera referred to both by Lewis (1974) and Parkin (1976) can be confirmed to relate to an <u>in situ</u> Silurian inlier there (Horne and Warren, in prep.).

Thus it seems clear that ice overtopped the lower cols of Sliabh Mis, and, on the balance of probability, it seems to have crossed from south to north bringing felsite from Killarney, silicified limestone from the Laune and Maine Valleys and Castlemaine Harbour and spreading Inch Conglomerate erratics from the southern to the northern side of the watershed (Fig. 4).

Lewis (1974) suggested that ice spreading from the east, in conjunction with ice from the north, could have carried Inch



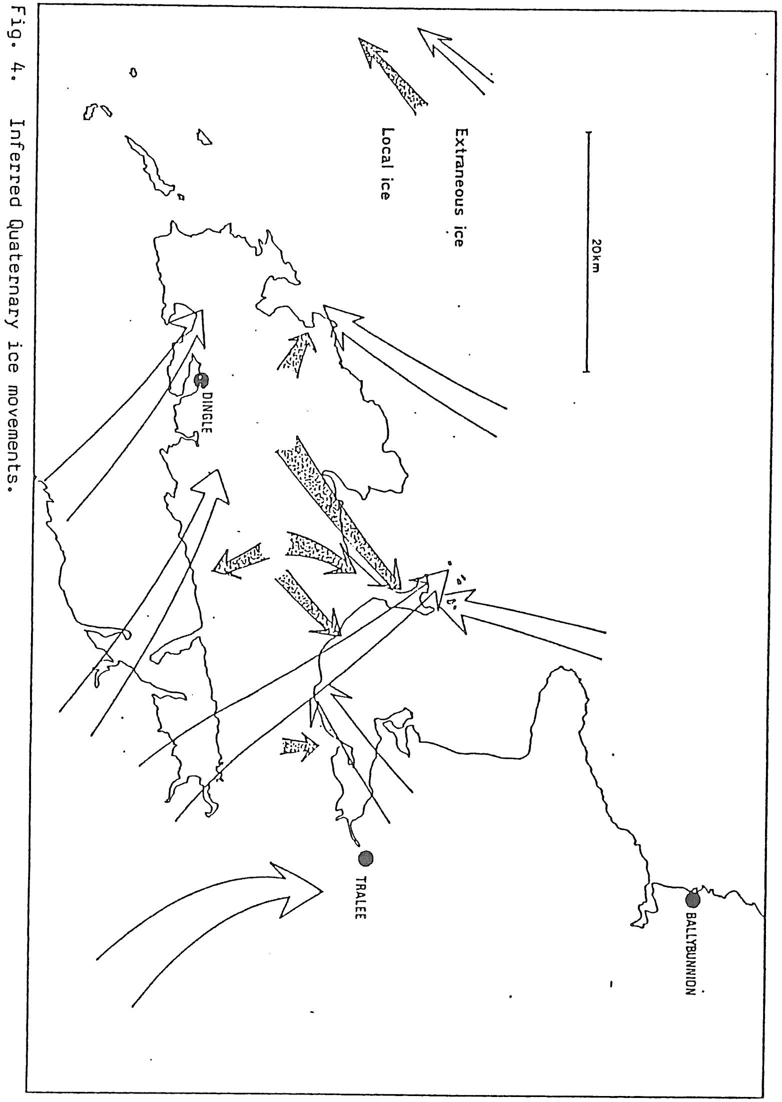



Fig. 4. Inferred Quaternary ice movements.

Conglomerate blocks from Derrymore Glen and spread them along the coastal area around Carrigaha. Although this might explain such erratics in Gleann na nGealt it could not explain them at Fahamore.

It is likely that the flint and chert erratics at Tra Beg and Ballymore were also deposited by ice from the south, as suggested by Lewis, as were the silicified limestones which have come to light in Geological Survey mapping in the Minard area.

Lewis (1974) recorded two till units containing silicified limestone,chert and flint erratics overlying a raised beach deposit at Feothanach on the shore of Smerwick Harbour. These erratics may have come from either the north or the south. However, the large ridge in which the till cliff is cut here and one to the east of it appear as though they may be outer moraines associated with Lewis' Ballinloghig Lobe. If this is the case then the erratics may be reworked.

In interpreting the stratigraphy, the raised beaches at Baile na nGall, Dingle Harbour and Ventry Harbour, all overlain by head, and those at Carrigaha and ?Feothanach, overlain by till, are usually correlated as a useful, potentially isochronous unit (Lewis, 1974; Warren, 1985). And,whereas Lewis (1974) regarded the raised beach as penultimate interglacial in age, I would suggest that they are likely to relate to the most recent interglacial.

The stratigraphic relationship between the raised beach and the Camp Till Formation is nowhere seen. At Carrigaha two till units are separated by a bed of more sorted debris. The lower unit contains Inch Conglomerate erratics but as yet none have been found in the upper unit (no systematic analyses have been carried out on these). Lewis (1974) suggested that both these units were deposited by ice from the Owencashla valley. I would tentatively suggest that the lower unit is the Tonakilly Formation, deposited by ice from the southeast, and that the upper unit may relate to ice from the Owencashla valley. Both these units overlie the raised beach and are therefore Fenitian in age. On the same principle the till at Feothanach, if the lower gravel there is the raised beach, must relate to the Fenitian.

This raises some problems in correlation from area to area. It suggests for example that Dingle Harbour, Ventry Harbour and the southern part of Smerwick Harbour around Baile na nGall were



unglaciated during the Fenitian stage while Feothanach and Carrigaha were. Whereas it may be argued that the Feothanach tills relate to a local glacier that emanated from Coumnacaillaigh in the upper Feothanach valley or that the gravels at Feothanach are not raised beach sediments, the succession at Carrigaha raises many questions. If, for example, the lower till at Carrigaha was deposited by ice that overtopped the lower cols of Sliabh Mis during the Fenitian, why did this ice not expand as far as the northern shore of Tralee Bay? Or are the Inch Conglomerate erratics in the lower till at Carrigaha re-worked ? There are many possible answers to these questions but more detailed work on the coastal areas between Camp and Fahamore may provide answers as mapping progresses.

The extent of local glaciation during the Fenitian as delineated by Lewis (1974) seems very limited. I would suggest that during this period, ice coming from Owencashla and probably Glanlough extended off the coast at Carrigaha; that ice extended far out of the Owenmore valley into Brandon Bay and on to the Castlegregory lowland where it probably joined with the Owencashla glacier which extended into the Owennamallaght valley. This is indicated by local till deposits along the coast and the disposition of moraine ridges in the Castlegregory area.

As indicated by the pattern of striae and ice moulded features in Coumanare, this upland basin, at about 370m OD, fed both the Owenmore glacier and the Owencashla glacier. Ice from this basin also extended through Lough Anscaul trough and down the Owenascaul valley to the village of Annascaul. A dry valley leads from the southwest edge of the outer moraine at Annascaul, as delineated by Lewis (1974), where the road to Killarney leaves the main road from Dingle to tralee. The genesis of the valley is not clear but it is likely that it carried meltwater from the Owenascaul glacier when its margin extended to this point. The question arises as to why meltwater did not follow the course of the present river and reach the sea at Bunaneer. A likely explanation might be that it was blocked by ice from the south. Again, more detailed work in this area may answer the question, with more certainty.

King and Gage (1961) counted 34 corries in Corca Dhuibhne. I have not attempted to count them but it is likely that some of them held ice during the lateglacial period in the Ballybetagh substage of Warren (1985), which is the Nehanagan stadial of Mitchell et al. (1973).

Postglacial sea level recovery here seems, at least in the late Littletonian, to have been continuous and no evidence has emerged from current work by Shaw, Orford and Carter (below) which would substantiate high sea level at 4.0m M.S.L. (Mitchell and Stephens, 1974). The question therefore arises as to what is the nature of the 8-10m high gravel ridge south of Ballybunnion on the northern side of the estuary of the River Cashin. This ridge contains shells (or they lie on the surface) and appears to be a storm beach. Is it consistent with storm conditions at current sealevel or is it possibly a remnant of the interglacial beach; the equivalent of the raised beach seen at Ballybunnion and south of the estuary on the bedrock platform?
(WPW)

## FIELD EXCURSION

### Site 1. GLEANN NA nGEALT (Q 674087)

Viewing Point

A view from here helps to place the sites on the north side of the peninsula in context. On a clear day Kerry Head is seen to the north. Ballybunnion (site 2) lies to the northeast of Kerry Head. Fenit (site 3) lies to the northeast directly across Tralee Bay from the viewing point. The Castlegregory tombolo and Fahamore (site 6) can be seen to the northwest. Camp (site 4) lies immediately below on the southern shore of Tralee Bay slightly east of north from the viewing point. A lateral moraine in the lower part of Owencashla valley (site 5) may be seen in the middle distance to the west.

Inch Conglomerate erratics scattered through Glenn na nGealt and extending as far north as Fahamore suggest an ice movement from the south. This movement was probably to the northwest as Inch Conglomerate erratics occur at Fahamore, but not on the northern shore of Tralee Bay. Warren (1980) suggested this ice originated south of the peninsula of Corca Dhuibhne, probably in the Kerry/Cork mountains and that it overtopped the lower cols of the eastern end



of the peninsula and extended into what is now Tralee Bay. An alternative interpretation was preferred by Lewis (1974, 1979) but this was prior to the discovery of Inch Conglomerate in Gleann na nGealt or at Fahamore (See "Quaternary Geology" above).
(WPW)

### Site 2. BALLYBUNNION (Q 860413)

This site which was first brought to my attention by G.F. Mitchell is included to help place the Quaternary sediments of Corca Dhuibhne in a wider stratigraphical perspective. Access is from the slipway at the beach at the southern end of the town, and the exposed sediments of interest extend for about 800m southwards from this slipway in a cliff 8-10m high.

At the northern end of the exposure a coarse diamicton is seen. It is compact, grey in colour and contains sandstone, shale and limestone clasts at its base. About 3m above the modern beach there is a concentration of well rounded clasts many of which are shattered and on end. Above approximately this level the diamicton appears less compact and is light brown in colour. Slumping and vegetation cover make thorough examination of the sediments difficult at this end of the site. A little more than halfway along the cliff, south of an old, broken retaining wall, exposure is much better and a clear sedimentary sequence is seen as follows:

4. About 1.0m fine-medium sand.
3. About 4.5m of light brown coarse diamicton with angular and subangular clasts of sandstone and shale with occasional limestone.
2. 2.8m of very well sorted beds of gravel and sand. The gravel clasts are very well rounded and tend to be flat. And are well imbricated in places. These sediments are strongly stained with manganese and iron and usually are seen to be the medium through which groundwater seeps to the face of the cliff.
1. 1.5m (exposed) of compact dark grey coarse diamicton with sandstone,shale and limestone clasts which tend to show a vertical a or b axis. Differential erosion at the contact between this unit and the overlying gravel has exposed a

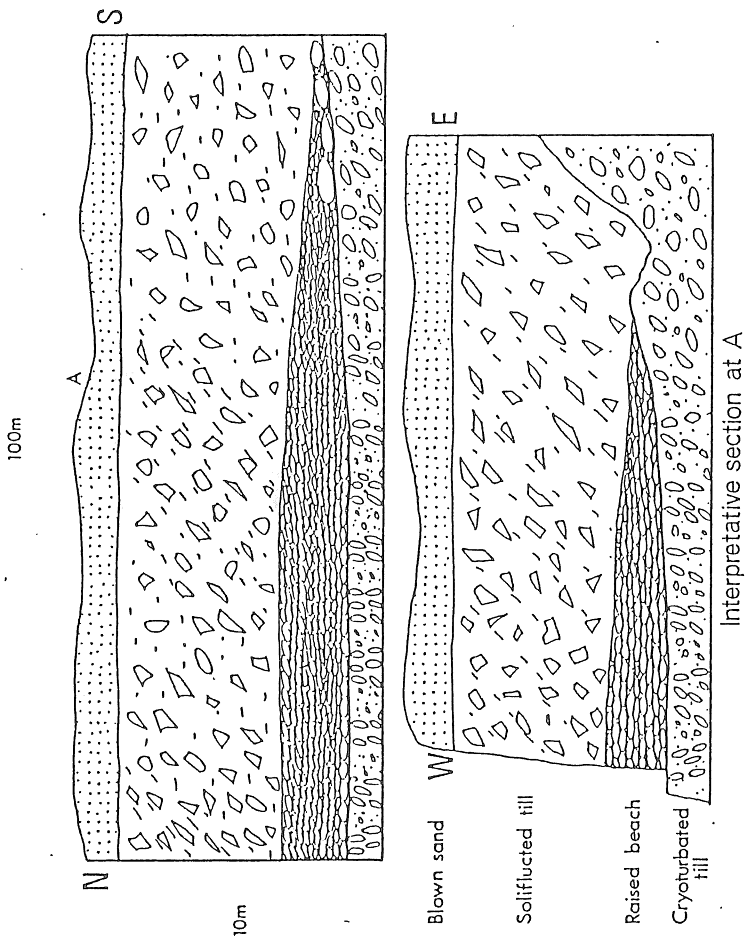



Fig. 5. Schematic diagram showing the chief sedimentary units at Ballybunnion.



platform that extends intermittantly along the cliff for more than 100m. The surface of the diamicton contains a thick iron pan.

This sequence is interpreted as a raised beach deposit resting on a cryoturbated till platform and overlain by a soliflucted till unit (Fig. 5). It is capped by modern blown sand. The questionable element in this interpretation is whether or not the light brown diamicton is an <u>in situ</u> till or a soliflucted till. The reasons I have interpreted it as a soliflucted till (following Mitchell, 1977, pers. comm.) are :

1. Both north and south of the raised beach outcrop, where the lower dark grey diamicton unit is in direct contact with the overlying light brown diamicton unit, the contact is very uneven.
2. At places pseudo-bedding structures can be seen sloping seaward in the light brown unit.
3. The upper unit has a coarser matrix and its clasts appear more angular and gelifracted than the lower one.
4. Immediately south of the Cashen River a similar raised beach gravel is overlain by a distinct head unit derived from the underlying bedrock.

The raised beach gravels at Ballybunnion were levelled in 1979 and were seen to extend from 7.08m OD at the base to 9.88m OD at the top.

The lower deposit here, the grey till has been named the Ballybunnion Till Formation. The raised beach has been correlated with the Courtmacsherry (Raised Beach) Formation of the south coast and the soliflucted till has been equated with the Fenit Formation (Warren, 1985).

The raised beach is referred to the last interglacial (following Bowen 1973 and Warren 1979, 1985) and the soliflucted till is regarded as a deposit of the last cold period, the Fenitian of Warren (1985). The Ballybunnion Formation is regarded as belonging to a cold period predating the last glaciation, the Ballybunnionian.

The sequence here is as in most stratigraphic situations a best fit interpretation based on the principal of the simplest

interpretation, essentially Occam's razor.
(WPW)

## Site 3. FENIT (Q 765147)

There is excellent exposure in the Quaternary sediments for a distance of 5km between Fenit and Spa on the north coast of Tralee Bay (Fig. 6). These were first described by Mitchell (1970) and have been somewhat reinterpreted by Warren (1981, 1985). The site being visited is at Ballymakegoge where Mitchell (1970) recorded the following sequence at profile DP 7.

| | |
|---|---|
| 0.0 - 0.3m | Soil |
| 0.3 - 2.0m | Upper Head |
| 2.0 - 2.4m | Glacial Deposit |
| 2.4 - 4.5m | Lower Head |
| 4.5 - 4.67m | Peat-mud |
| 4.67 - 4.75m | Silt |
| 4.75 - 5.50m | Lower Head |
| 5.50 - 6.50m | Silts and peat muds |
| 6.50 - 6.80m | Sand |
| at 6.80m | Shore platform |

The upper head was described as being composed of sand with angular shale fragments, sandstone and silicified limestone, and was noted to be cryoturbated to 1.75m from the surface. The glacial deposit was described at this point as an horizon of red sandstone boulders up to 1.0m long. The lower head is a stratified loamy sand with angular shale fragments and rounded sandstone pebbles. A fine silt-rich layer within the Lower Head was recorded between 3.9m and 4.5m. The peat-mud at DP 7 is fine grained with some sand, but with layers richer in sand and silt. The head in the lower silt/peat-mud sequence is described as "sand packed with small stones". The lowermost silt contains peat lenses. Further east at profile DP 8, almost 2.0m of rounded shale fragments lying horizontally with some large sandstone boulders at the base is interpreted as a raised beach deposit.



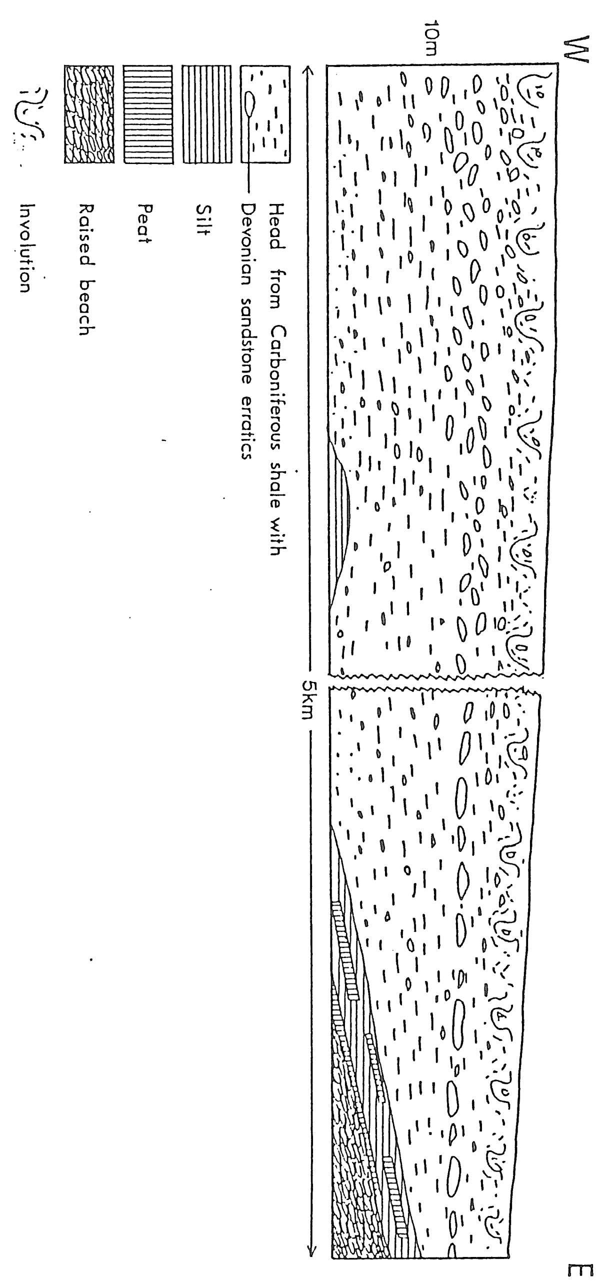



Fig. 6. Schematic diagram showing the outline sedimentary sequence between Fenit and Spa.

Mitchell (1970) interpreted the glacial deposit in the middle of the sequence as having being deposited glacially between the deposition of the upper and lower head. I regard the whole sequence from the silt upwards as a solifluction deposit largely of local gelifracts but containing varying amounts of erratic sandstone. A little more than halfway up through the section, there is a distinct concentration of sandstone erratics, many of which are striated. This may reflect a former pocket or ridge of till which provided debris to the solifuction apron as a degrading cliff-line moved landward, or it may be a lag layer reflecting a change in slope dynamics for a period. Other, more complicated, interpretations are possible, but it is difficult to see anything more than solifluсted debris above the peat deposits. Indeed much of the peat in this locality may be in secondary position, interbedded with the silts which are the basal unit of soliflucted sediments. The lower peat which now outcrops through the modern beach seems to be in situ. Michell (1970) regarded the small basins in which the beach occurs as dune slacks.

Pollen in the lower peat indicate open pinewood and later treeless countryside and may reflect the end of an interglacial period and beginning of a cold stage. Alternatively it may represent an interstadial period. Some of the basal silts at the base of the soliflucted unit contain pollen indicative of interglacial conditions (Abies, Alnus, Corylus, Ilex, Picea, Taxus Allmus, Rhododendron and other Ericales). But pollen in the interdigitating peat suggest colder conditions. Mitchell (1970) suggested that the best interpretation of this sequence was that the pollen in the silts were derived from soil or organic deposits that were disaggregated during the early stages of solifluction activity. I would accept that they represent the surviving organic remnants washed down to shore level from soils further up-slope with the other fines that form the basal silts that characterise many soliflucted sediments (see Watson and Watson, 1970). It is logical to assume that these organic deposits are derived from sediments that accumulated during the interglacial period that immediately preceded the cold period which was responsible for the solifluction activity. Moreover, the position of these polleniferous silts,



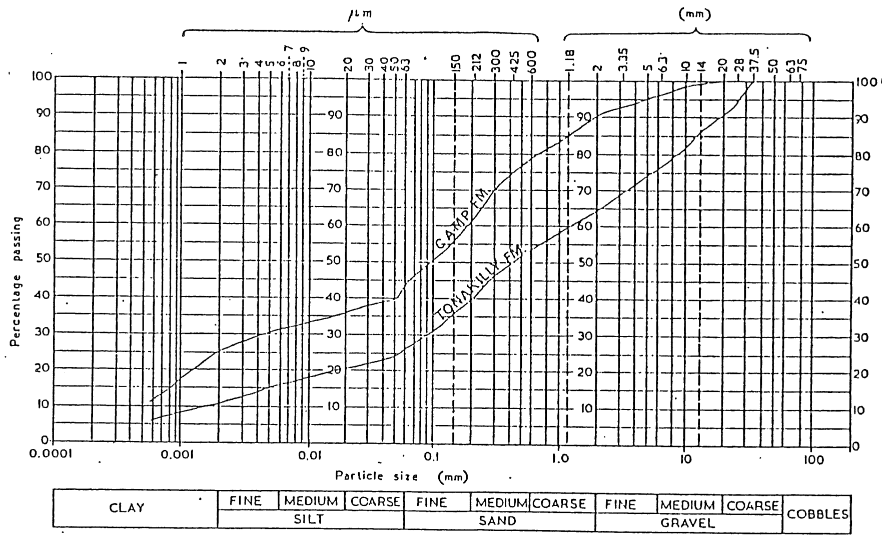
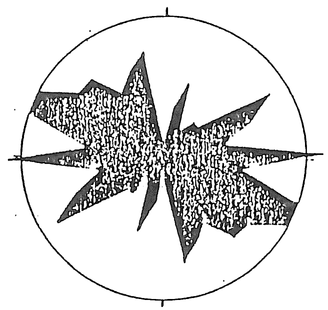



Fig. 7. Cumulative frequency curve for particle size in the Tonakilly and Camp Formations.


TONAKILLY FM.

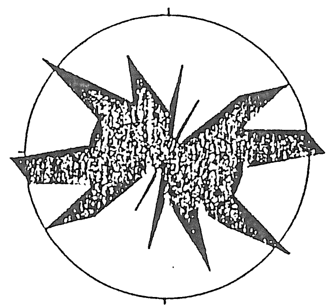

CAMP FM.

Fig. 8. Diagram to show preferred orientation of stones in the Tonakilly and Camp Formations; 100 stones in each sample; one radius represents 9 stones.

relative to the underlying peats which reflect open pinewood, suggest that the peats represent the closing phase of the interglacial as Mitchell (1970) suggested rather than an interstadial. I also accept that the raised beach sediments were probably deposited during this interglacial.

I have interpreted this sequence as showing a transition from one warm stage through the succeeding cold stage and suggest that these were the last interglacial and last glacial periods, respectively, in Ireland. I have named the soliflucted unit the Fenit Formation and, as the sequence from the lower peat upwards is a conformable sedimentary sequence showing this transition from warm to cold conditions, I have used it as the stratotype for the sediments of the last cold period which I have termed the Fenitian (Warren, 1985).

In the absence of any in situ glacigenic sediments in this sequence we cannot conclude that this area was glaciated during the Fenitian.
(WPW)

Site 4. CAMP (Q 689107)

This site, close to the village of Camp, is in the townland of Tonakilly. It is, yet again, a coastal section and is easily accessible as it is right at the point where the road from Camp to the church at Tonakilly meets the coast. Both to the east and west of the foot of this road two distinct till facies are normally visible. The section to the west of the road is the more instructive. Immediately west of the road is 4-5m of brown/red till containing abundant Devonian sandstone with lesser amounts of black cherty shale and grey silicified limestone. Erratics of the Inch Conglomerate Formation also occur. Directly underlying this till is a light brown till composed of black cherty shale, Devonian sandstone, silicified limestone and olive green/brown sandstone that may be either upper Devonian or Namurian (0.7m exposed).

These two units are visually very different and both particle size analysis (Fig. 7) and contained clast type analysis (pebble count) confirm this (Table 1). The main constituent of the lower unit, the cherty shale (Clare Shale Formation) has its nearest



outcrop to the northeast in the Fenit area. The main constituent of the upper till, Devonian sandstone has a generally southerly provenance. The upper till has been informally termed the Tonakilly Till Formation and the lower till informally named the Camp Till Formation.

Table 1 Percentage stone count from the 5-14mm fraction in the Tonakilly and Camp Formations.

| | Camp Fm. | Tonakilly Fm |
|---|---|---|
| Devonian Sandstone/shale | 49 | 80 |
| Sandstone and shale of uncertain provenance | 7 | 16 |
| Clare Fm. Cherty shale | 17 | 1 |
| Carboniferous silicified limestone | 18 | 2 |
| Quartz | 7 | 1 |
| Other | 2 | - |

A close examination of this section will show that although the contact between the tills is very clear there is some interdigitation between them suggesting that in its upper levels, at any rate, the lower till was reworked during the deposition of the upper one. This is confirmed by the striking similarity between the rose diagrams representing the orientation of the a axis of a hundred pebbles from each of two sample points within each unit (Fig. 8). The diagrams are quite dispersed but they seem to show a movement to a point slightly west of northwest or east of southeast. The precise direction from which the lower till was originally deposited is as yet unclear although the erratics would suggest a northeasterly provenance, unless the Clare Shale Formation passes out under the sea to the north of Tralee Bay; in which case a north-south direction is possible. A similar sequence is seen at Kilshannig at the end of the Castlegregory tombolo. Here a stoney till dominated by Carboniferous shale and cherty shale (Clare Shale Formation) underlies a till dominated by Devonian sandstone. Although the upper till at Kilshannig is frost disturbed, the lower one seems undisturbed and produced a stone orientation diagram relfecting a north/south fabric. The upper till produced an east-west orientation but the value of this is in question owing to the disturbed nature of the till.

At Camp the two tills can be traced westward for about 200m but as the upper till thins westward the contact is obscured by deep cryoturbation features from the point at which the total cliff height falls below about 3m.

The involutions here take the shape of festoons of coarser stones with much finer material towards the centres. In places the finer material is composed largely of black shale while the coarse material in the feature is sandstone. At one point there is a very strong concentration of cherty shale forming a horizontal bed at the base of the festoons. It is possible that the contrast between the sandstone till on top and the less permeable shale till below influenced the development of these periglacial features at this locality.

Further west, at Carrigaha, Lewis (1974) recorded two tills overlying a raised beach deposit. Both of these are sandstone dominated tills, but the lower of the two contains Inch Conglomerate and may be regarded as belonging to the Tonakilly Formation. The Camp Till Formation is not seen at Carrigaha and it is possible that it predates the raised beach which underlies the tills and head there.

The raised beach at Carrigaha is correlated with the beach at Ballybunnion and at Fenit and consequently the overlying sediments are placed in the Fenitian Cold Stage. Thus the Tonakilly Formation at Camp belongs to the Fenitian stage while the age of the Camp Formation is unknown.

Limestone erratics have long been known from the Finglas River valley south of Camp (Rowan 1852) and I have recorded a till with limestone underlying a sandstone till in that valley. It is not



clear whether this till and the erratics are associated with the Camp Formation. Also, right on the col over which Bóthar na gCloch (the "scenic route" to Inch, between Knockbrack and Caherbla) passes I have found silicified limestone to be a common erratic. It is also commonly found in till sections on the southern flanks of the Sliabh Mis to a height of 520m but I have no records of the Clare Shale in these areas.

Thus, given the distribution of Inch Conglomerate erratics, Killarney Felsite (see above) and silicified limestone I conclude that ice from the southeast pushed over the Sliabh Mis ridge and passed over this area moving to the northwest. And, although ice from the north clearly impinged on the north coast here its southern extent remains unknown.

(WPW)

**Site 5.** OWENCASHLA (Q 600080)

Our route from Camp takes us up to the Valley of the Owencashla through Gleanntín Easaigh forestry park and back to the main road through Owennamallaght valley.

In this area there is clear morphological evidence that ice moved northward out of the mountains towards the coast. Lateral moraine terraces sloping down valley are seen on both sides of the Owencashla. A set of terraces, one on either side of the valley forms a lobate ridge which crosses the valley at about 50m OD. This is the accumulation of drift referred to by Lewis (below) and which he regards as the outer limit of the Lesser Dingle Glaciation.

I have been unable to find any stratigraphic reason to support this interpretation. Indeed even on a morphostratigraphic basis it is hard to see the basis for it, for there is immediately outside this moraine another ridge which extends much further northward and is the probable equivalent of a similar feature that extends northward from the western side of Owennamallaght valley; it is marked by the 30.5m (100ft) contour as it crosses the main road just east of the junction for Castlegregory. Other clear lateral moraine terraces can be seen above this one on the western slopes of Owennamallaght valley.

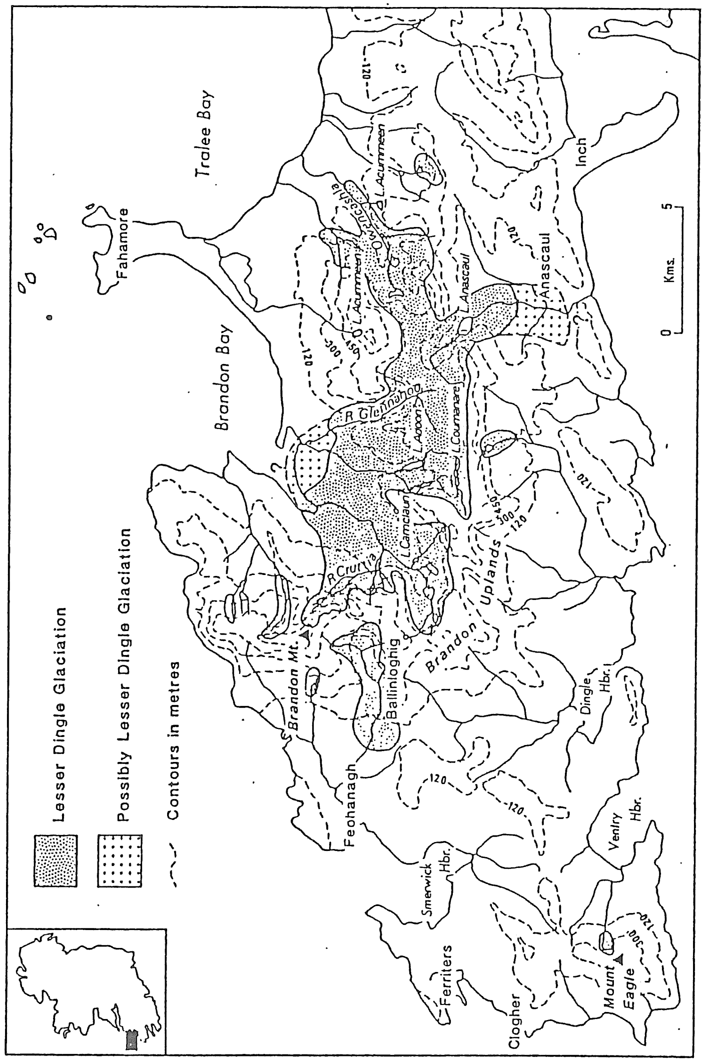



Fig. 9. Extent of Lesser Dingle Glaciation.



There is general agreement however as to the interpretation of the glacigenic features seen in the upper part of the Ownencashla valley as they are described below.
(WPW)

**Valley Glaciation**

The Floor of this valley is choked with drift at altitudes around 50m OD. Although it is not well exposed it is likely that this debris marks the maximum stage of ice advance down the valley during the Lesser Dingle Glaciation (Fig. 9; Lewis, 1974). Alluvial deposits terminate at the upstream side of the drift mass and form the cultivated area of the valley floor.

<u>View point</u>: from the road 300m northeast of the point where the stream from Lough Acummeen flows under the road.

Lough Acummeen, on the south side of valley, occupies the basin that formerly contained a cirque glacier. That this glacier probably merged with the main trough glacier is suggested by what appear to be lateral morainic terraces on the opposite side of the main valley: no such terraces cross the mouth of Acummeen. The cirque moraines (more than one morainic ridge is identifiable in the vicinity of the lake) presumably post date the Lesser Dingle maximum.

A wad of drift occupies the sides of Owencashla valley in the vicinity of the entrance to the Forestry plantation. A section about 4m high on the west of the forest road, across the valley from the cottage with the tiled roof, shows the nature of the deposit. Trees now obscure the view, but in 1974 I stated that this deposit formed part of a large moraine that sweeps across the valley floor at about 90m OD (Fig. 9).

From the site of this section it is possible to obtain an impression of the 'large and morphologically very fresh moraine (that) enclosed the downstream side of Lough Slat' (Lewis, 1974). Trees now cover the moraine, but looking up-valley from the section, along the line of the forestry road, about 300m up-valley, the trees are seen to occupy a ridge that is part of the Lough Slat moraine complex. 'This was formed by ice flowing down the main valley and down the tributary that leads from the Knocknakilton plateau to the south' (Lewis, 1974).

What appears to be a nivation ridge (protalus rampart) exists on the Knocknakilton plateau. The ridge encloses Cummian Lough. View point: from the forestry road, about 150m up-valley of the section at a minor bend with four large boulders on the section (left) side of the road.

Another section shows the local nature of the tills. View point: beside forestry road at road junction signposted "Car Park, Picnic Area, Walks".

i) Lough Caum and Doo Lough are enclosed by blocky moraines. Lough Caum is separated from Doo Lough by a morainic ridge (Lough Caum is north of Doo Lough). These ridges are now forested.

ii) Above Lough Caum, 'to the north-east, lies a diminutive moraine, probably formed around a local snow bed or small glacier' (Lewis, 1974).

iii) Up valley of Doo Lough is a minor block moraine.

Lewis (1974) concluded that moraines i) and iii) were not due entirely to local cirque ice, but that the glacier responsible for their formation was 'fed by ice from the west', i.e. from the Coumanare plateau ice-cap. At a later stage Lough Caum held a cirque glacier. The precise relationship of the ice/snow bodies to the ice field on the adjoining plateau is not entirely clear in this complicated area. Was, for example, the outermost bouldery moraine of Lough Caum formed by a mixture of plateau-fed and local, cirque, ice and the inner bouldery deposits due only to cirque ice? If so, where did the plateau ice terminate when only cirque ice occupied Lough Caum? At Doo Lough, perhaps? Or are the deposits at Doo Lough due also to cirque ice?

View point:

i) From the car park beside signpost stating "Lough Caum".

ii) An excellent section in the blocky moraine exists 100m west of road junction signposted "Way out".



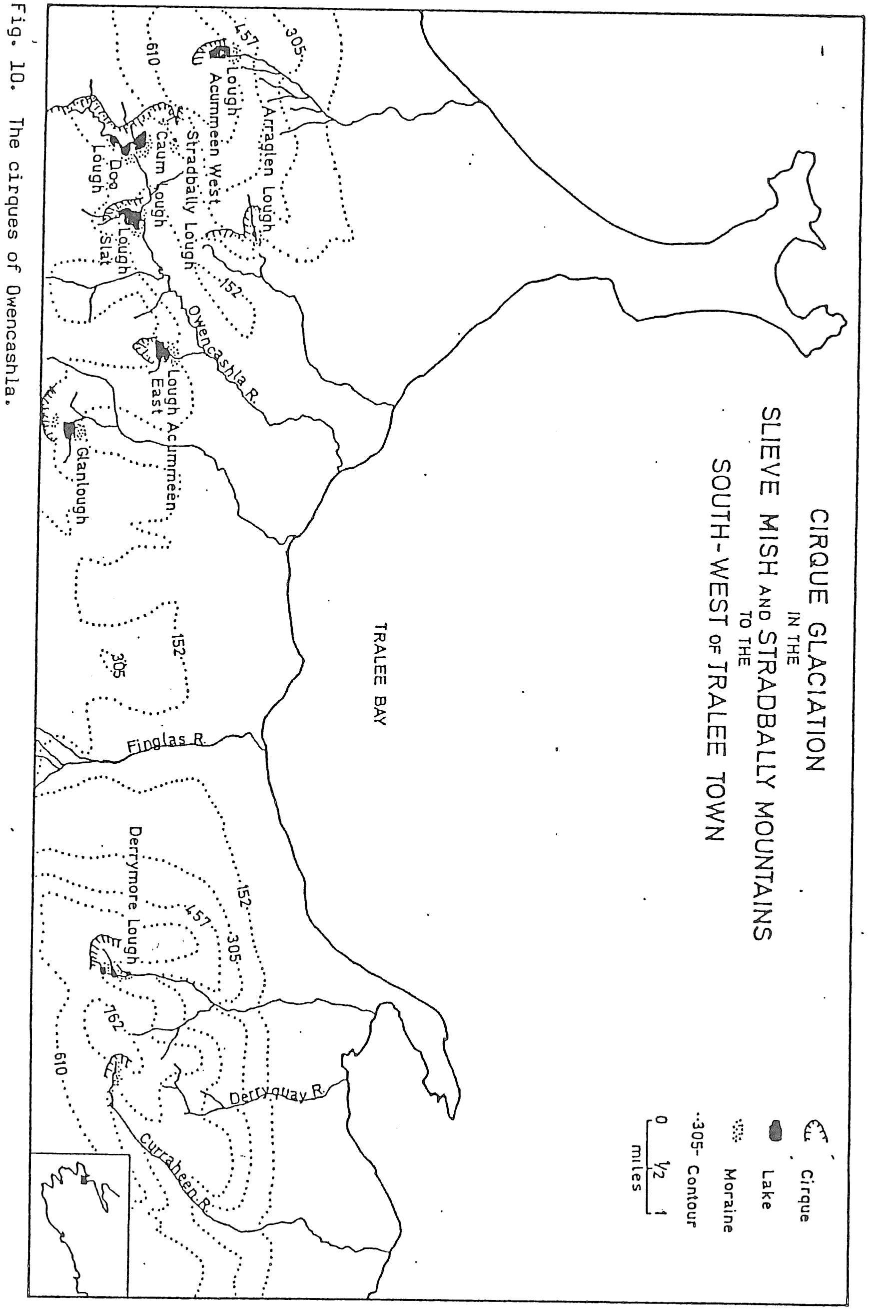



Fig. 10. The cirques of Owencashla.

View point: an excellent view of Lough Slat is obtainable from the signposted "Viewing Point", with a picnic table, benches and litter bin adjacent. Note from here that the screes above Lough Caum are still partially active.

Warning: The Owencashla valley is served only by a narrow tar road and by gravel forestry roads. These roads are not suitable for coaches and it is advisable not to use a vehicle larger than a mini-bus on them.
(CAL)

## Cirque Glaciation

### Description

The horseshoe-shaped cirque complex at the head of the Owencashla valley is composed of four separate cirques (Fig. 10). A nameless cirque lies to the south-east of Stradbally Mountain. This cirque contains a double morainic sequence: a shallow depression bordered on the down-valley side by a breached ridge is succeeded altitudinally in a south-easterly direction by a lakelet which is bounded by a lobate moraine along the south-eastern shore (Fig. 11). To the south of this is the cirque whose basin is occupied by Lough Caum. The moraine which encircles the lake along the north-eastern and eastern shores is oriented obliquely within the cirque backwall and sidewalls and extends in a westward direction into the south-eastern end of the lake to form a lunette shaped promontory. Doo Lough, which drains into Lough Caum, is located further south still and occupies the basin of the third cirque. The relatively subdued moraine which impounds this lake along the southern and eastern shores is aligned parallel to the sidewall and continues in a north-easterly direction to impound the south-eastern portion of Lough Caum (Fig. 11). The basin of the fourth cirque contains moraine-impounded Lough Slat which lies to the east of Lough Caum and Doo Lough and is located further down the Owencashla valley (Fig. 12). A fifth cirque has been eroded into the southern side of the valley further down stream and is marked by the impounding moraine, lake and backwall at Lough Acummeen (Fig. 13).



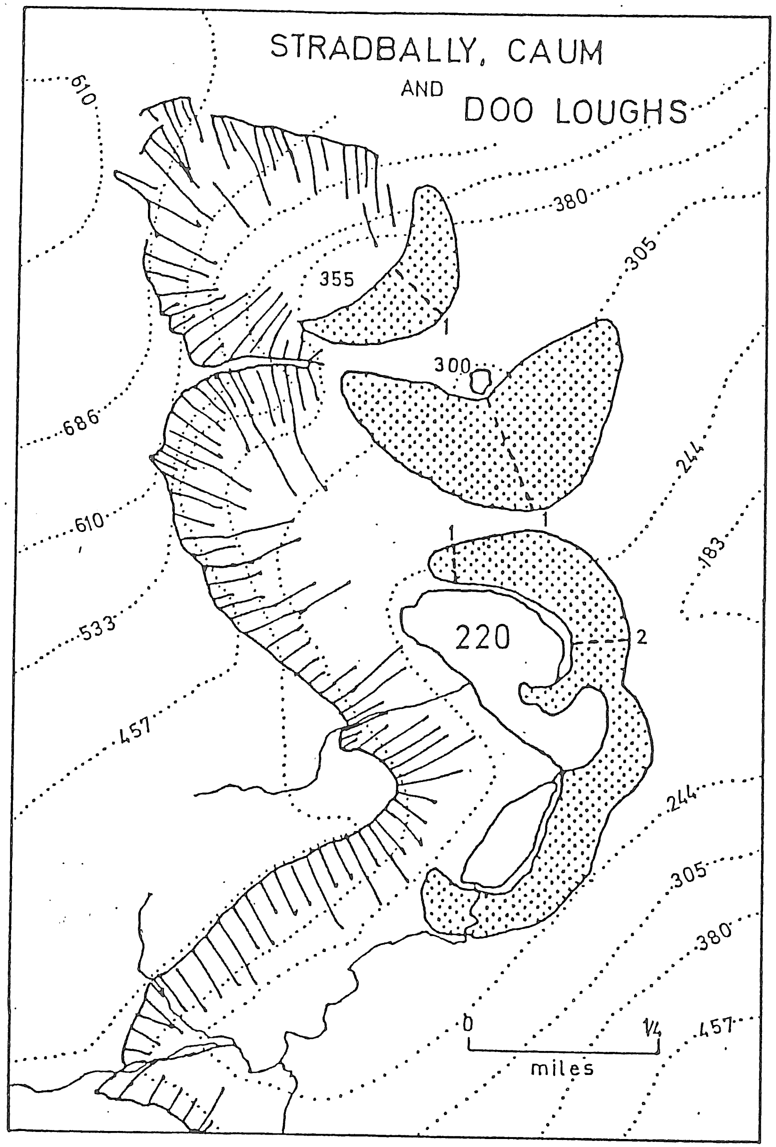



Fig. 11. Stradbally, Caum and Doo Loughs

Discussion

Of the five cirques only the inner and outer moraines to the southeast of Stradbally Mountain, and the moraines at Doo Lough lie above the 210m, contour (Table II).

TABLE II Orientation and Altitude of Owencashla Cirque Moraines*

| Moraines | Orientation (degrees) | Altitude (metres O.D.) |
|---|---|---|
| Stradbally Inner | 145 | 355 |
| Stradbally Outer | 160 | 300 |
| Lough Caum | 140 | 220 |
| Doo Lough | 150 | 225 |
| Lough Slat | 64 | 115 |
| Lough Acummeen | 39 | 170 |

* Based on Benner (1972).

As no erratic limestone material was observed in any exposure in the glacial sediments at the head of Owencashla, it may be assumed that the Owencashla valley was occupied by a local valley glacier at the time of, or since the extension of lowland, limestone bearing ice into the northern foothills of the Sliabh Mis and Stradbally Mountain ranges. Lewis (1974) suggested that the source area for the Owencashla glacier was the ice moulded eastward extension of the high ground of the Coumanare plateau to the west and southwest of the trough's end and that the blocky moraines of Lough Caum and Doo Lough were not in fact the products of true cirque glacierisation, but merely represented a final phase in the Owencashla valley glaciation. In the same paper Lewis suggested that the moraine which encloses the downstream side of Lough Slat was also formed by main valley ice.

Certainly, on the basis of the plan profile of the moraines around Lough Caum and Doo Lough, it is possible to argue for an input of ice from the west as the maximum thrust appears to have



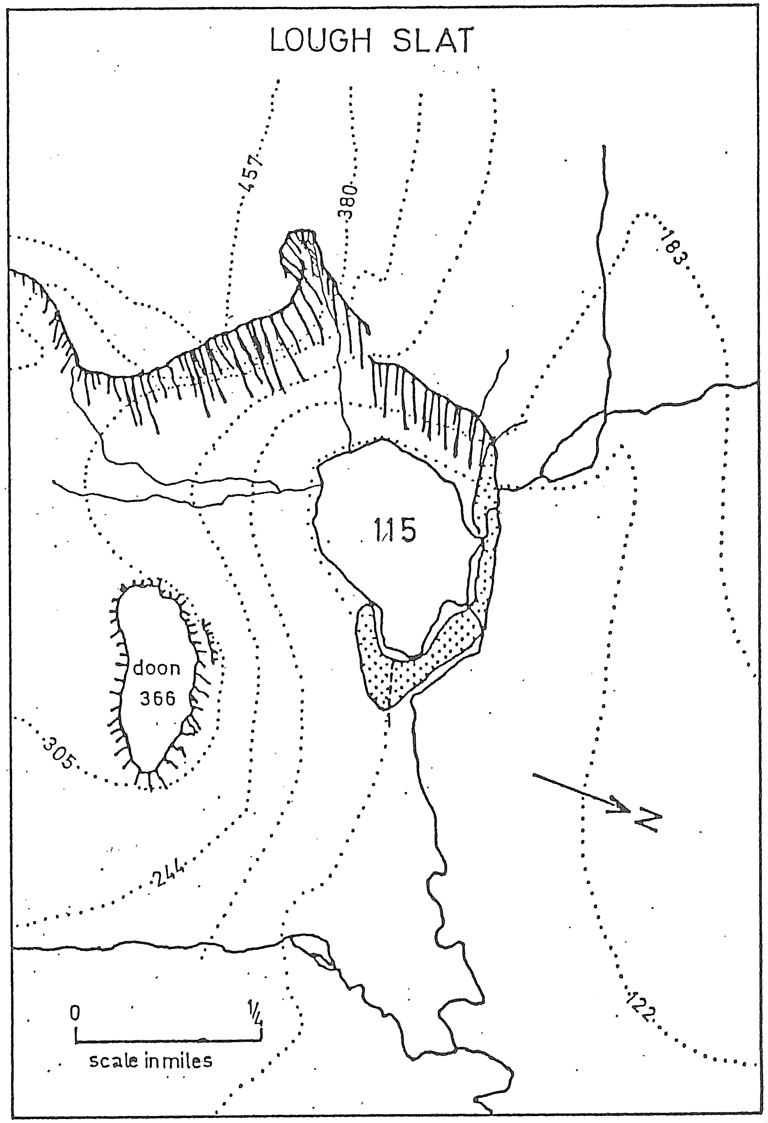



Fig. 12. Lough Slat.

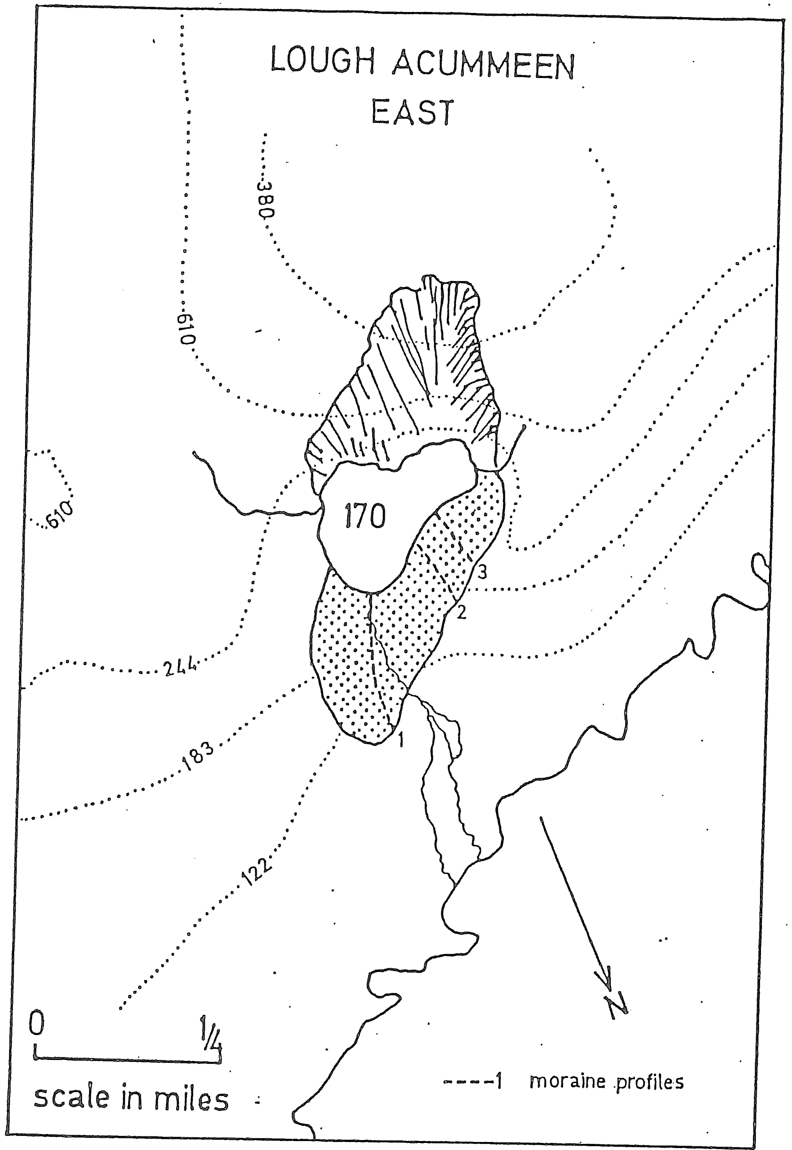



Fig. 13. Lough Acumeen East.



been from that direction. However, in the case of the Lough Slat moraine it is difficult to envisage anything other than a purely local cirque origin as the plan view of the moraine represents an accurate mirror image of that of the arcuate backwall and therefore suggests that the maximum thrust of the depositing ice emanated from within the cirque itself.

Conclusion

It is clear that the cirque moraines in the Owencashla valley which lie below the altitude attained by the Lough Caum and Doo Lough moraines must post-date the main valley glaciation. Only the two moraines to the southeast of Stradbally Mountain which lie above the Lough Caum and Doo Lough moraines could have existed before or during the maximum advance of ice down the valley. The simplest interpretation of the evidence is to assume that the four moraines (those at Lough Caum, Doo Lough, Lough Slat and Lough Acummeen) were formed penecontemporaneously as the valley glacier finally retreated. Either the inner or the outer moraine to the southeast of Stradbally Mountain could be correlated with this event. Assuming that both moraines lay above the limit of valley glaciation, then the most likely probability is that the outer moraine was formed during the main valley glaciation and that the inner moraine formed along with the other four moraines during the final phase of valley glacier retreat.

The dating and correlation of these moraines is highly speculative as no datable deposits within the sediments have yet been observed. Traditionally, correlation between cirque moraines has been carried out on a morphological and sequential basis. This is at best a hazardous occupation frought with unsubstantiated assumptions such as uniform rates of erosion and deposition etc. Indeed it is very probable that many of the cirque backwalls and basins have been occupied many times over by cirque glaciers and have therefore a polygenetic and polycyclical origin.

Correlation on a wider scale is based on the findings of others (Lewis, 1974; Warren, 1979, 1985). Glacial sediments associated with the expansion of ice from the Owencashla valley have been recorded as overlying the raised beach deposits at Carrigaha on the

south side of Tralee Bay (Lewis, 1974). It is assumed that the raised beach at Carrigaha is synchronous with the Courtmacsherry Raised Beach (Wright and Muff, 1904). This unit is accepted as an isochronous marker horizon associated with relatively high sea level during the last interglacial (Warren, 1979; Bryant and Quinn, 1979). Therefore the Owencashla glacial sediments are probably associated with the maximum of the last glacial, and the cirque moraines could therefore be attributed with a lateglacial age, possibly the end of the Maguiresbridge Substage (Warren, 1985). It is quite possible that this stage was followed by a further cold phase in the Owencashla area as evidenced by the nivation ridge at Cumminan Lough above Lough Slat (Lewis, 1974).
(IMQ)

## Site 6. FAHAMORE (Q 610182)

The Castlegregory tombolo connects the Magharee islands to the mainland. The tombolo appears to comprise marine and aeolian sediments, although lacustrine and alluvial facies may be superficially present. Guilcher and King (1961) have described the morphology of the tombolo and commented on its probable origin in the light of Holocene sea-level change.

At Fahamore at the northern end of Brandon Bay, peat outcrops on the beach foreshore (Fig. 14). The lowest peat (at about Poolbeg datum) rests on a wave eroded surface cut into till. This till is remarkable for the vast amount of vertical stonework. The overlying fen peat which has been dated to around 4400 bp (Fig. 14) includes a number of erect in situ tree stumps and many fallen trunks and branches. Of four sampled, three were Betula and one Salix. The Salix stump has been dated to 4065 ± 60 bp. Preliminary pollen data indicate a freshwater fen environment, dominated by Alnus, Betula and Coryloids. Herb pollen is uniformly low throughout the peat.

Near the top of the present beach (around 3.5m OD) small, impersistent outcrops of organic rich sands occur. The relationship between these upper and lower organic deposits is unclear, although they appear to be separated by marine sands. In the dune scarp several palaeocatenas are evident, rising and falling alongshore. In one locality a buried wall (possibly of late-medieval age) was



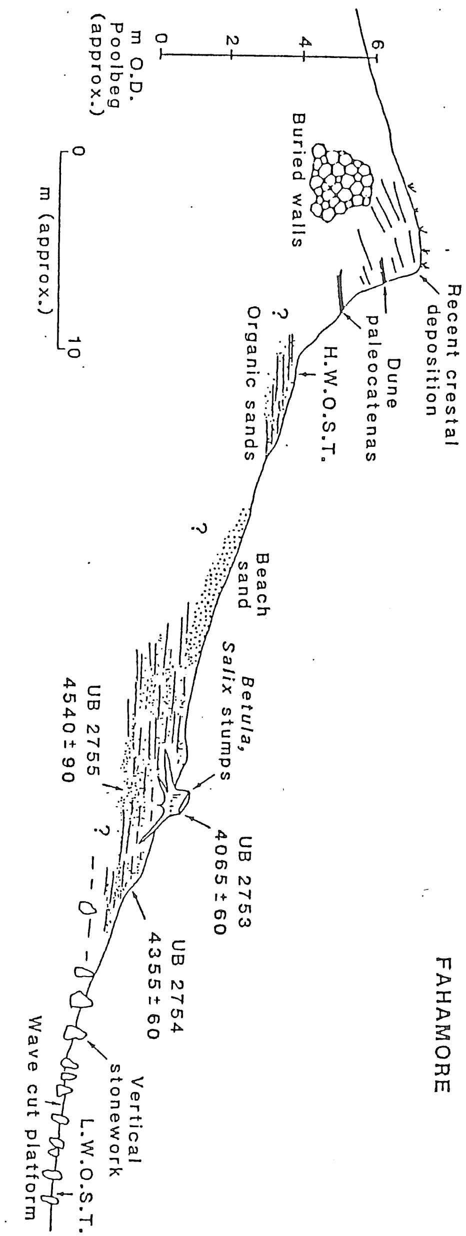



Fig. 14. Cross-section through the site at Fahamore.

exposed in March 1986.

At this juncture it is hard to place the Fahamore site into its proper context. The position and dating of the lower foreshore peat argues for a lower mid-Holocene sea-level, although compaction and geomorphological changes blur any simple pronouncements. It seems likely that the Castlegregory barrier moved landward over the back-barrier fen sometime after 4000 bp. This process is still continuing.

Recent fieldwork has involved sampling the back barrier to the east of Castlegregory village (Q 635132) where fen peat appears to be underlying more recent saltmarsh.
(JS, JO, BC)

Near this site (Q 609193) a large granite boulder about 2x3x3.5m lies at about 17m OD. It rests on a thin cover of till which covers the limestone bedrock here. Brindley in Lewis (1974) related it to the Murvey granite of west Galway. Smaller pieces of similar granite can be found in the modern beach in the area.

To the east, on the coast near Kilshannig Point, small pieces of granite occur in till and in an overlying gravel. The till is composed of grey and black shale, chert, pieces of olive green/brown thinly bedded sandstone (either Namurian or Lower Carboniferous/Upper Devonian) and small amounts of Devonian sandstone.

North of the village of Kilshannig at Cloghaturrish (Q 625198) two till units are exposed. The lower unit (about 0.5m exposed above the modern beach) is composed of grey and black shale, chert olive green/brown thinly bedded sandstone and occasional Devonian sandstone clasts. It is overlain by the upper till unit, 2.0-2.5m thick, which contains Devonian sandstone with chert and black shale and is deeply cryoturbated. These units are interpreted to be the lower (Camp Formation) unit and upper unit as exposed at Camp (Site 3).

Inch Conglomerate erratics are quite common in this area. They are found mainly in the modern beach and foreshore but also, though less commonly, in till. Invariably when the Inch Conglomerate is found in situ in till it is in till of the upper facies type. The indications here, as at Camp, are of an ice movement from the north



or northeast followed by one from the south or southeast.
(WPW)

## Site 7. LOUGH DOON (PEDDLERS LAKE) (Q 503060)

Enroute to Lough Doon, on the road to Conair (Pass) we travel up the Owenmore glen from which ice extended northeastwards into Brandon Bay and was fed by ice in Caumanare, though Glenahoo, Lough Adoon and Lough Camclaun to the south. We pass the mouths of these glens and can see some of the glacial features associated with them.
(WPW)

### Glenahoo (Q 544102)

A section in outwash deposits is exposed on the Dingle side of the bridge where the main road crosses the Glenahoo River. There appears to be flow till in the section. The deposits assume the form of an outwash terrace and were associated with the melting of the Glennahoo glacier. This was another of the outlet glaciers of the Coumanare plateau ice mass of the Lesser Dingle Glaciation. Because of the incorporated flow till this section is regarded as marking a limit of Glennahoo ice. In 1974 Lewis wrote 'The Gl moraine is of a kame-like nature and there are no moraines up-stream of it'.

By 'kame-like' I intended to convey the impression that the deposits were water-lain, i.e. as in a kame terrace; perhaps I should have described them as glacial outwash with incorporated flow till. I explained the lack of moraines up-valley of this deposit as due to the watershed between the Coumanare Lakes and the head of Glannahoo: 'As the ice-cap shrunk in size so it appears that ice was no longer able to surmount this watershed and reach the head of Glenahoo. This meant that the glacier there became isolated from its sources of supply and hence melted in situ, forming the washed kame deposits at the valley mouth'. (Lewis, 1974). The last home of ice on the Coumanare plateau I believe to have been where the Coumanare Lakes now are; note from the O.S. map how the lakes are particularly shaded, with an appreciable headwall. The lakes are worth visiting, although very isolated, because of their associated glacial landforms.

The deposits that partially impound these lakes are seen from the main road, vide Lewis (1974).
(CAL)

Lough Doon

Access to Lough Doon is from the small car park beside the waterfall about 1.5km on the north side of Conair.

As we walk up to the lake we walk over a cirque rock-lip which is very well ice moulded and striated. Below the road a pond can be seen. This is dammed by a small but very clear moraine ridge which loops down from the side walls of the cirque basin. This is the first cirque basin and associated moraine in Ireland to have been described, as such, in the scientific literature (Ball, 1849). The degree of preservation of striae on the rock lip, although common in the mountains of Kerry, is remarkable. In addition to striae, crescentic gauges and cracks can be seen. As the direction of former ice movement is obvious here it is a useful locality at which to discuss the merits of these features as ice direction indicators. The cirque basin is oriented slightly west of north and, due to its position in under the northeast slope of Slievanea, is extremely well shaded from insolation particularly in winter time. For a good overall description of the site it is worth quoting Ball (1849) at length.

> "The most accessible, and at the same time the least doubtful site of an extinct glacier which I observed, is traversed by the road which descends from the summit of Connor Hill, towards Tralee Bay. After winding along the face of the steep cliffs of Connor Hill, the road passes at a distance below a wild rocky hollow in the mountain, which contains a small lake or tarn, called on the ordnance map, Lough Doon. The streamlet which descends from this hollow forms, at a considerable distance below the road, a second small lake, called on the maps, Lough Beirne. A small glacier appears to have filled up the hollow now occupied by Lough Doon, and to have decended nearly to the level of Lough Beirne. The first indication which strikes the observer who ascends from the road to the upper lake, is the regular and uniform manner in which the rocks at the north-western side of the lake are rounded and smoothed. This appearance is not confined to the flat ledges which lie immediately between the lake and the slope of the mountain, but extends to the steep rocks which form the amphitheatre, reaching to the height of eighty or ninety feet (judging from recollection) above the level of the lake. I observed some traces of furrowings on the surface of these rocks, similar to those which are the common results of the passage of glaciers in the Alps; but as they were not very distinct, and as their origin might possibly be attributed to other causes, I should not have considered the evidence sufficiently conclusive, were it not for the distinct and well characterised moraine, which extends from a little below the upper lake nearly to the level of Lough Beirne. The position of this moraine, which is altogether inexplicable by an hypothesis as to the effects of currents of water, seems to me to leave no room for doubt, to any observer accustomed to the appearance of those bodies. Although its dimensions are masked by the growth of a turf bog upon either side, it forms a distinct and almost continuous ridge, easily traceable by the eye, and which is found on walking along it, to be chiefly composed of large angular blocks, precisely as is seen along the banks of recent glaciers. It is worthy of remark, that this moraine is by no means regularly parallel to the bed of the streamlet, by which the drainage of the upper lake is now conducted".

Further comment would be superfluous.
(WPW).

Following the retreat, or dissolution, of the main Owenmore valley glacier, a number of small glaciers descended from localities around the head of Owenmore to terminate on the main valley floor,

where their deposits impound small lakes. The glacier that descended from Lough Doon formed a moraine that is partly responsible for impounding Lough Beirne. Clogharee Lough is impounded by deposits derived from ice that descended from Coumeenoughter. Lough Gal and Lough Duff are impounded by terminal moraines of the Owenmore glacier. The Coumhenry moraine is also associated with ice in the head of the Owenmore valley. This moraine occurs at the head of the main valley above, and to the left of the uppermost farmhouse in the valley (with a red roof).
(CAL)

**Conair (Pass)**

View point: car park. Lough Cruttia with its impounding moraine is seen across the Owenmore valley. Cruttia is the lowest of a remarkable staircase of lakes that rise, step by step, towards Mount Brandon. This staircase is well worth climbing, if only to see the boulders with tails of finer debris, sitting on an ice moulded rock pavement, that are still in place on the upper part of the "staircase", as if the ice had only melted yesterday. Warning: the upper parts of the "staircase" can only be reached by a certain amount of rock climbing.
(CAL)

**Site 8 INCH (Q 642008)**
**Castlemaine Harbour**

Although the evolution of coastal landforms in Dingle Bay and Castlemaine Harbour has been discussed by Guilcher and King (1961), virtually no corroborative research has been undertaken since their pioneering study.

A number of questions are posed by the arrangement of the coastal forms dividing the outer Dingle Bay from the inner Castlemaine Harbour. For example, are the spits (the word "spit" is used here only in the morphologic sense) of similar age, or is there an order of development ? Furthermore, are the spit positions (two on the south shore, one, interposed, to the north)) of any significance in terms of origin and evolution ? It is clear that any discussions of these questions rests, as Guilcher and King were



aware, on the sea-level history of Dingle Bay. Information on this topic is singularly lacking.

It is probable that the early Holocene sea-level rose to flood Dingle Bay around 10000-8000 bp, reworking the extensive glaciogenous deposits both on the northern flanks of Macgillycuddy's Reeks and the southern flanks of Corca Dhuibhne. Reworking of boulder or gravel size material along the shore is likely to have resulted in coarse barrier beach ridges, which in time acted as nucleii for the development of aeolian sand dunes. The present complex of spits would seem to have formed in relation to the tidal estuarine dynamics of Castlemaine Harbour. The meandering of the main estuary channel has both developed and in turn influenced the position of the three spits. Inch spit is perhaps the most striking morphologically. This huge, sand rich system is maintained by the almost constant cycling of sediment from the ebb shoals to the beach, through the dunes and back into the estuary channel. The deposition rates at the distal point appear so great as to preclude effective vegetation stabilisation. Inch spit may be transgressing slowly, as sand is lost offshore and inland.

In 1984, a 0.65m core was taken at Cromane Point (Q 700000). Carbon-14 dating of the top and bottom of this core gave ages of 450 ± 70 bp (UB-2756) and 2330 ± 75 bp (UB-2757) respectively. A pollen diagram (Fig. 15), shows very low tree (12.7% peak) and shrub (14% peak) presence, while in the herbs and spores there is interplay between a few dominant pollen types. At the base *Calluna* dominates, while just above *Pteridium* is more abundant. As *Pteridium* declines upwards so grasses become more common. The top three samples contain high amounts of Compositae liguliflorae, Chenopodiacea and *Plantago maritima*. It is not clear exactly what palaeoenvironment this sequence represents, but it would appear that terrestrial influence had waned and given way to marine over the period 2500 to 500 bp. After 500 bp it appears beach barrier sediments overwhelmed the site.

Partly in order to resolve the problems posed by the Cromane Point information, further cores have recently been taken at Inch (V 660985) and Knockaunnaglashy (V704967) on the southern shore of Castlemaine Harbour. At the latter site a 4m core penetrating salt

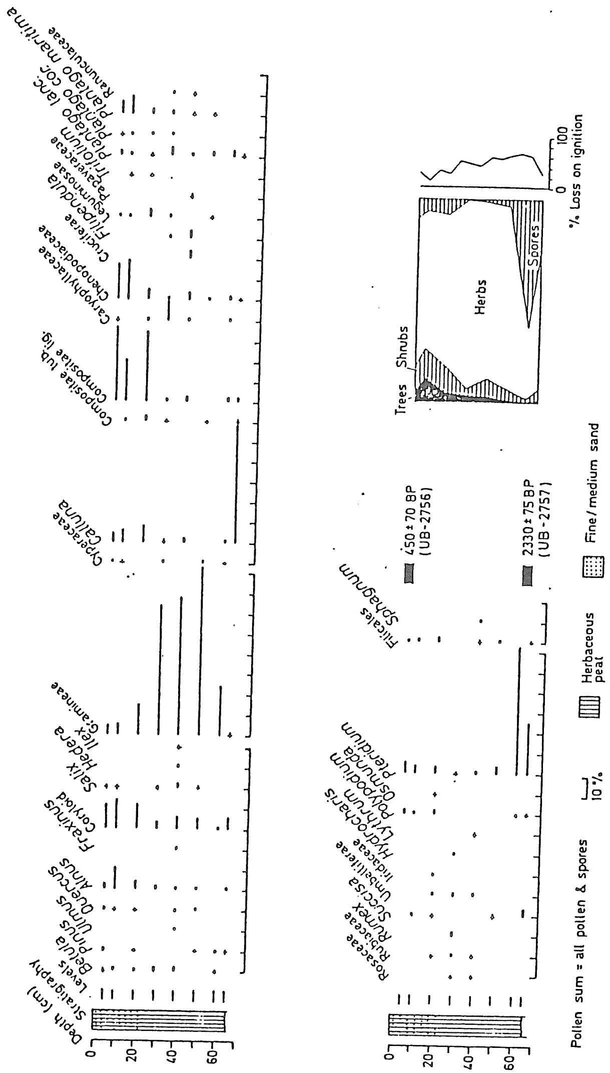



Fig. 15. Pollen diagram from short core taken at Cromane Point, Castlemaine Harbour.



marsh and freshwater fen peat was obtained. The preliminary palynological results indicate a gradual flooding of the estuary over the last 5500 years, from a sea-level about 5m below present. The gradual change from terrestial to marine conditions is punctuated by three clear marine innundations (storm surges?) in the period 3000-1200 years bp.

As yet the Inch cores have not been analysed, and no samples from either site have been submitted for $^{14}C$ dating.

Summary of relative sea-level (RSL) changes around Dingle

So far the evidence suggests that sea-level has risen monotonously throughout the mid- and late-Holocene, and probably before this as well. The estuaries are being flooded. This view confirms speculations by Devoy (1983) and Taylor et al. (1986). However our recent results provide a far more reliable estimate of the rate of sea-level rise, and should assist in unravelling the evolutionary sequences of the coastal landforms both to the north and south of Dingle.
(JS, JO, BC)

## Site 9 LOUGH ANSCAUL (Q 583049)
Owenascaul valley

The Owenascaul drains the southernmost portion of what has been referred to as the Coumanare plateau. The head of the valley forms a spectacular trough, complete with lake. Scree deposits mantle the valley on either side of the lake. A spectacular moraine, associated with a glacier that descended from the cirque of Tooreenmartin, exists on the valley floor up-valley of the lake. A gravel terrace exists up-valley of the moraine.

View point: the car park at the end of the tar road at Lough Anscaul.

1. Looking up-valley from the car park the terminal moraine formed by ice from Tooreenmartin is seen as a ridge on the eastern side of the head of the Lough and as a ridge up which the gravel road winds about 1km up-valley.

2. Walk 100m up-valley. A section on the left of the gravel road exposes scree. On 11/7/86 till was seen underlying the scree about 5m above the level of the track. Note how the scree tends to fine upwards.

3. Walk up-valley to the shed with associated sheep dip-trough. The moraine of the Tooreenmartin glacier lies 100m up-valley of the shed, ascended by the track. The glacier came down the western side of the valley, as the stream does now, from the cirque on the plateau.
Notice the lateral moraine leading down the valley side and into the terminal feature. Looking back towards the Lough one sees the down-valley end of the terminal moraine as a mound partially surmounted by scree, and at two places hidden (or destroyed) by debris cones.

4. Walk up-valley along the gravel track to see the gravel terrace that leads from the vicinity of the plateau to abut against the moraine of the Tooreenmartin glacier on the floor of the main valley. The advance of the Tooreenmartin glacier responsible for the deposits at the head of Lough Anscaul postdates the retreat of the main glacier that led down from the Coumanare plateau and that was responsible for the glacial features at the lower end of, and down-valley of, Lough Anscaul.

5. Return to the car park. Look at lower end of the lake, note the ice-scoured rock on west of the lake, and the moraine-like landform with farm and bungalow on it to east of lake. These features were formed by the Annascaul glacier, an outlet glacier for the Coumanare plateau ice-mass. Further glacial deposits exist between the lake and Annascaul, but are nowhere clearly exposed. The limit of ice of the Lesser Dingle Glaciation probably lay between the lake end and the vicinity of the village of Annascaul. In 1971-73 road cuttings exposed local till between the bridge in the village of Annascaul and the speed restriction sign on the Dingle side of the village, along the main road to Dingle. This till may have been associated with the Lesser Dingle Glaciation.

No tills associable with the Lesser Dingle Glaciation have been recorded along the southern coast of the peninsula. A large flint erratic was discovered in till at Ballymore, an inlet on the eastern side of Ventry Harbour, and is thought to date to the Greater Dingle Glaciation and to witness ice advance from the vicinity of Killarney, where chalk deposits are known to exist (Lewis, 1974).
(CAL)



Site 10 MINARD (V 556991)

The road past Minard Castle runs across a small storm beach composed of large well rounded sandstone boulders. The beach material is derived from well bedded and jointed sandstone of the Kilmurry Formation (Devonian). These were interpreted by Horne (1975) as aeolian dune beds associated with arid desert conditions. A brief examination of the shore material will show that the rock breaks readily into regular cube shaped blocks which are gradually rounded as they are worked by marine action along the shore to the beach. Large beach cobbles and boulders frequently have to be cleared from the road in the wake of winter storms.
(WPW)

Site 11. BAILE NA nGALL (Q 376067)

This is another coastal site. The exposure is in a small cliff behind the beach just south of the pier at Baile na nGall. Here the following sequence is seen

| | |
|---|---|
| 0-0.5m | Medium sand |
| 0.5-2.0m | Angular fragments of local shale and sandstone in a sandy matrix. The larger clasts are arranged in festoon structures. |
| 2.0-3.0m | Well sorted gravel composed of flat rounded cobbles resting on a level rock platform. |

Bryant (1966) interpreted the sequence as a raised beach resting on a marine-cut platform and overlain by cryoturbated head which incorporated some beach sand. It is modern blown sand on top. This interpretation has generally been accepted. (Lewis 1974, Warren, 1985).

The raised beach deposit here extends from about 5m to 6m OD and I would correlate it with the Courtmacsherry (Raised Beach) Formation and suggest that this section indicates that this locality remained ice free during the Fenitian. This may not, however, be true of Feothanach just 3km to the south (see below).
(WPW)

Site 12 FEOTHANACH (FEOHANAGH) (Q 389094)

View point: turn towards sea beside public house at Feohanagh cove. Park at the corner where a grassy lane leads off the tar road. Walk along the grassy lane crossing a stone wall. (note: the lane has been eroded by the sea and ends in a cliff). Scramble down superficial debris to the rock platform in cove from which a radio mast is visible. Walk to the rock platform at the western end of cove (take note of tidal conditions).

Here the following is seen:

i) Local head about 3m thick rests on rock platform.

ii) Till overlies head (Feohanagh Till).

Walk east from rock platfrom for about 140m.

i) Laminated clays/sands about 2-3m thick. Are these: a) lake b) outwash (c) marine deposits ?

Walk east for about 50m.

i) Gravelly deposits, layered, about 2m exposed on 11/7/86, some "beds" of sand and/or finer material. Are these: a) beach b) outwash deposits? In 1972 I recorded these deposits as underlying the laminated clays, but on 11/7/86 the relationship was not clear. Note major slump at foot of cliff between the two deposits. This cliff retreats fairly actively. In 1972 I recorded :

"Sand 1-1.5m

Pebbly layer 1-2m (this horizon was not seen in 1973, and may have been eroded by coastal erosion)"

overlying the laminated clays that we have already looked at.

ii) Till, about 6m, overlies the gravelly deposits. It has occasional chert erratics.

Walk east to the rock platform.



i) Head occurs again on rock platform, overlain by laminated deposits and till.

ii) Note green sandstone erratic in till directly above cove end of rock platform.

iii) Gravels overlie till. In 1972 I recorded 'Sand with pollen 0.3-0.45m' overlying the gravels. Professor J.J. Moore obtained pollens of Gramineae, Juniperus, Cyperaceae, Salix and Ericaceae from these sands.

iv) Upper till with flint, chert and silicified limestone erratics, 2m.

v) Sand about 1m.

Bryant (1966) considered the upper till is 'Eastern General till' derived from 'an ice advance from the north and east'. He 'believed that the lower boulder clay was local in origin.' (Lewis, 1974).

A number of questions arise in relation to these deposits

1. Is the "head" a head?
2. Are the 'gravels' a beach deposit?
3. Is the 'lower till' a glacial deposit?
4. Is the 'upper till' a glacial deposit?
5. How were the 'laminated' deposits formed?

In 1974 I interpreted the deposits as follows:

a) beach formation.

b) cold conditions, head formation.

c) 'Ice from the north then pressed across the mouth of Smerwick Harbour at the same time that a lobe of northern ice entered the area via Brandon Creek [and intermingled with local ice from the western valleys of Brandon Mountain]. A temporary lake, witnessed by the clays, formed between the two ice masses, being obliterated by the continued ice advance that deposited the lower boulder clay' (i.e. the Feohanagh Till).

d) An interstadial, witnessed by the pollen from what I called the Feohanagh Pollen Sands.

e) Readvance of invading ice 'probably comingling again with local ice', that flowed west across the area, entering the Atlantic at Ferriter's Cove and Clogher Bay.

f) Recent wind blow sands.
(CAL)

Site 13 DUN AN OIR (Q 331050)

Geology

Setting/Site Description

The Dún an Oir/Ferriters Cove area is bounded to the north and east by sand dune, constituting the modern golf course. To the south a small stream, issuing from the dune area, marks approximately the southwestern/western limit of the dunes and the begining of a freshwater fen. The fen lies within a series of interconnected, shallow (4-5m deep) basins. Sediment sequences thin eastward here toward a subdued ridge (solid), which forms a divide from the 3-4m thick freshwater peat deposits on the western side of Smerwick Harbour. Coring work has not shown any evidence of a connection between these two areas. The whole of the Dún an Oir area thus lies within a syncline formed by rocks of Silurian and Devonian age. To the north it is bounded by steeply dipping shales, slates and quartzites, forming at the coast the spectacular cliff of Sylil Head - Three Sisters.

Accurate survey work on the area is far from complete. A number of sites are of interest but two in particular will be discussed here (Fig. 16).

A. The shore platform, contiguous with the sand dune/midden sites

B. The central marsh-fen

A. - Stratigraphy

The stratigraphy here is most fully developed at the headland zone (1). The following sequence may be observed:-

1. Grey-white, fine-medium sand, forming sand dunes. High $CaCo_3$ content (40-50% by weight) composed of finely comminuted marine shell fragments and land mollusc shells., Thickness 1-3m. Indurated horizons and blocks of sand are found, particularly at the junction with 2.

2. Grey, yellow-brown, clayey sand-silt, with angular gravel sized fraction present. Thickness 5-10cm. This layer dips strongly and thins northwards. Sharp transition with 1, with occurrence



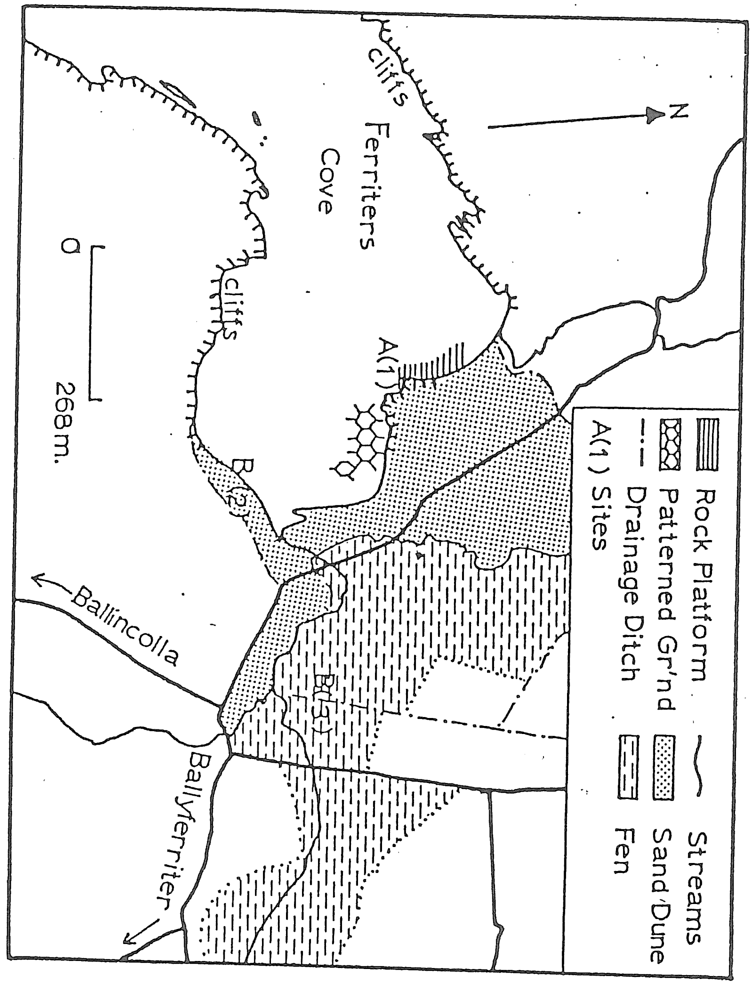



Fig. 16. Site location, Ferriters Cove.

of charcoal and shell material (middens) along this junction zone.

3. Shattered, angular stones (slates, sandstone, shales) yellow-brown, sand silt matrix fining up to merge with 2. Material is highly contorted, with cryoturbation structures common.

4. Rock 'platform' dipping seaward from beneath 3 at 5-10°. Maximum height is + 2m HWM. Bedrock dips at 70-80° with bedding planes - structural weaknesses selectively exploited by marine action.

Northward from this headland occur the excavated midden sites (See Woodman, this guide) beneath a thickening sand dune cover, the junction of 1/2 occuring here at +1m HWM. Excavations show a split surface to 2, tentatively interpreted as a "notch" or bevel formed at its seaward end, together with a thinning and coarsening of this layer consistent with the selective removal of fines at this point.

Interpretation Development of the site - sediment sequence is problematic. The age of the rock platform, presumably a marine erosion surface, is unknown (see Devoy, 1983). Its primary formation must pre-date lateglacial time ( 11,000 bp), although present storm activity affects sections of the exposed surface. The overlying shattered and cryoturbated stone layer was presumably formed under periglacial conditions between 10,000 - 11,000 bp. Stone polygons may be identified at low tide where this layer intersects the foreshore south of the headland (1). The finer layer 2 is probably derived by sorting and slope wash from 3. It appears in Section 3 and excavation to have a 'planed surface'. A suggestion has been made that this may represent a marine washing surface, as supported by the morphological evidence and apparent spatial variation in sediment size distribution. If this is the case, then it would evidence the operation of isostatic depression of the area, as marine action would not have reached this level if the layer were to have formed at its present elevation. However, no identifiable marine sediments are associated with the layer and the morphological features are uncertain. Variations in the spatial sediment pattern at the junction of 1/2 is more likely to result



from the effects of groundwater percolation through the dune cover and laminar flow at the 1/2 boundary. Water movement here also probably accounts for the concentration of indurated sand blocks at this junction rather than evidencing different stages of sand dune formation ("older" = hardened blocks) as some have suggested. The age of the dunes is similarly unknown. They probably formed late in the postglacial and seaward of the current shoreline in response to recruitment of shelly-sand with rising sealevel. The lack of soil or vegetation stabilization horizons is striking, by comparison with the structured dunes of Donegal and the Magilligan Foreland in County Derry (Wilson and Carter, 1984). The lack of these horizons supports the idea of continuous dune mobility during the postglacial, whilst local observations suggests that their current stability dates from the extermination of the rabbit population in the 1950's.

B - Stratigraphy

South of the headland A (1) the solid geology dips to form the largest and deepest of the basins of the Dún an Oir area. This dips gently seaward. The basin is infilled by a 4-6m sequence of inorganic and organic deposits of postglacial age lying above the periglacial deposits of 3. The sequence is partially exposed in a low cliff at the southern margin of the bay B(2) showing in its upper section *Phragmites* monocot peat overlain by grey, olive -brown clay-silt and then sand. As the ground surface rises to the south the clay-silt interfingers the peat, evidencing the periodic operation of solifluction - slope wash processes. Cores through the peat exposed on the foreshore show a thickness of 1.0-1.5m, monocot peat with sand partings being replaced downward by alder-oak, fenwood peat. Landward, sand covers the former fen surface with a layer of variable thickness ( 1.0-1.5m) reaching a maximum depth to bedrock of 6-7m beneath the present golf course to the north.

Eastward from the coast the sand cover gives way to the development of a freshwater *Phragmites* fen - reedswamp. Coring work here shows a highly variable stratigraphy, influenced by fluctuation in the limits of blown sand cover and freshwater stream meandering.

A reasonably representative core taken at B(3) shows the following stratigraphy:-

| | | |
|---|---|---|
| 1. | 0.0 - 0.34m | Soil layer giving away to grey-brown clay-silt. High content of monocot roots |
| 2. | 0.35 - 1.37 | Yellow-white, grey sand (fine-medium) with broken shell/fraction. Modern plant stems throughout and organic content. |
| 3. | 1.37 - 1.42 | Dark-medium brown organic sandy clay/silt with high sand content. Roots still present. |
| 4. | 1.42 - 1.49m | Fine-medium coarse sand (white-grey) |
| 5. | 1.49 - 1.61m | Dark-medium brown organic rich clay/silt. High sand fraction still amongst plant stems - bedded. |
| 6. | 1.61 - 1.78m | Coarse yellow-grey sand, with small organic clay/silt partings. |
| 7. | 1.78 - 1.85m | Medium brown organic rich sand, with <u>in situ</u> monocot stems and roots. |
| 8. | 1.85 - 1.95m. | Coarse yellow-grey sand. |
| 9. | 1.95 - 1.96m | Organic rich sand |
| 10. | 1.96 - 2.54m | Fine-coarse yellow-grey sand. |
| 11. | 2.54 - 3.26m | Dark-medium brown organic rich clay/silt. Monocot stems and leaves present. Sharp boundary with 12. |
| 12. | 3.26-3.45 | Medium brown monocot peat with high clay /silt content. |
| 13. | 3.45 - 3.58m | Grey clay/silt |
| 14. | 3.58 - 4.06m | Dark brown homogeneous fibrous wood peat. |
| 15. | 4.06 - 4.07m | Grey sandy clay/silt |
| 16. | 4.07 - 4.15m | Grey-blue sandy silt with angular stones. |

In other cases a thicker sequence of monocot peat and development of 15 is found.

## Interpretation - Environmental Data

A study of pollen and vegetation remains from the site shows development of an initial alder-oak-willow fenwood forming under high groundwater conditions. This is replaced upward by a *Phragmites* - Cyperaceae reedswamp with fringing fen-marsh, essentially as found today. $^{14}C$ dates are awaited, but relative pollen dating suggests peat formation beginning after 5,500 bp. Examination of the diatom assemblage in the basal clay/silt shows a brackish-freshwater assemblage indicator of some marginal marine influence.

As in A(1) the site evidences landward migration of blown dune cover during the postglacial, its eastern margin expanding and contracting out of the reedswamp-marsh surface. Discovery of any climatic significance in the timing of dune expansion would depend on a more detailed stratigraphic and dating scheme than currently envisaged. Landward retreat of the shoreline is evidenced by exposure of peat on the foreshore. Probably the fen plant communities filled much of the present Ferritiers Cove, forming in response to a rising groundwater level with postglacial sea-level recovery. These plant communities may have formed an important resource attraction to the "midden hunter-gatherers". Direct marine inundation of the remaining fen area is unproven, but brackish water seems to have found its way along low lying basal channels at about 5,000 BP.

(RD)

## Archaeology

Excavations have been taking place at Ferriters Cove, Co. Kerry, since 1983. The potential importance of this site was first noted by Dr. P. Vernon in a short note in the <u>Journal of the Cork Historical and Archaeological Society</u> when he recorded his discovery of a Neolithic artefact. This turned out to be a fragment of a flint plano-convex knife.

As until recently, there had been little clear evidence for a Neolithic in Co. Kerry and in particular in Corca Dhuibhne, this discovery was of some importance. Careful examination by the Dingle Archaeological Survey revealed that there was a series of very small shell middens exposed along 100m of coastline and that due to coastal erosion, these were falling into the sea. Therefore, a programme of excavations was initiated in 1983. So far, four locations have been examined or are under investigation.

Excavations have shown that the sites lie on a wave-cut platform which lies roughly 1-2m above high water mark. The shell middens are rather small, usually only about 1.0m across, and they represent only a fraction of the activities going on at the site. One of the most interesting aspects of the excavation is the range of raw materials used for the manufacture of stone tools. While there is a limited use of flint, presumably based on the procurement of flint nodules from the nearby beach, the main sources are the local volcanics - Rhyolites and Volcanic ashes. These have been used to produce a heavy bladed industry reminiscent of that found during the Later Mesolithic in more northerly parts of Ireland. A few Later Mesolithic artefacts such as Bann Flakes, core borers and a pick have been found during the excavation. Thus a range of artefacts of both Neolithic and Mesolithic form have been discovered. This trend in artefact types is confirmed by $^{14}C$ dates which are:-

Site I    5230 ± 200 bp
          5190 ± 110 bp

The plano-convex knife was found on the foreshore adjacent to this site.

Site II    5580 ± 110 bp.
           5620 ± 80 bp

This site is now the subject of an ongoing major excavation.

Site III    5310 ± 130 bp
            5270 ± 90 bp

So far, no other diagnostic Neolithic artefacts have been discovered and both pottery and the bones of domesticates are so far also absent. The economy practiced was, therefore, that of a hunter/gatherer in which a range of fish, including cod, tope and wrasse, were caught, while the shoreline provided not only crabs but a range of shellfish, including limpets, periwinkles and whelks. Shellfish were often collected very selectively and one species of one size are often found lying in one of the small middens. So far, the bones of wild boar are the only mammal bones definitely identified.



Besides the shell middens, occasional hearths and dumps of burnt stone have been found. However, no traces of structure or pits have so far been uncovered. Thus a large area has been opened in order to examine the full extent of one (if not two) campsites. The second season of this large-scale excavation is being undertaken in 1986.

(PW)

Site 14 AN RIASC (Q 373046)

Carriag Bheag

This is one of a number of tor-like features that extend in an arc around the inner part of Smerwick Harbour. They are formed of a distinctive well bedded conglomerate, the outcrop of which they represent. An examination of these features revealed that they are notched, usually at a clear bedding plane, at several levels. Preliminary levelling at an Charraig Bheag showed that the notching and platform development extends between about 8m and 12m OD. The notches generally have a flat base and concave overhang and are very similar to both modern sea notches and those on the raised platform in the Devonian rocks of the south coast.

My initial interpretation is that these are indeed sea notches in what were at one time small stacks or skerries relating to a slightly higher sea-level. As these are erosional, not depositional, features there is no stratigraphic control which would indicate their age. However it is intended to level them accurately in the course of the coming year to determine if there is a pattern of levels that extends from one to the next. Given that this area appears not to have been glaciated during the Fenitian Stage it is possible that some, if not all, of these notches may relate to last interglacial (Gortian) high sea-levels.

It is possible that some of these features relate to the platform described by Devoy (above).

(WPW)

## ADDITIONAL OPTIONAL SITES

15. CALLARAS (Q 395046)

This is an Early Christian oratory. It is the best preserved of the so-called "boat shaped" oratories in Ireland. It is almost perfectly preserved, perhaps the most remarkable feature being the beautifully constructed corbelled roof. There is some debate as to the age of the oratory, but it is almost certainly older than 10th century and may be as old as 7th century.
(WPW)

16. CILL MAOLCHEADAIR (Q 403061)

This is an Early Christian/Medieval Church complex and includes an Hiberno Romanesque church (mid 12th century), the Chancellor's House (medieval), "St. Brendans House" (medieval) and ?two Early Christian corbelled oratories. This was obviously an important medieval church settlement. It was at times the residence, and through the medieval period was the prebend of the Chancellor of Ardfert.
(WPW)

## REFERENCES


BALL, J. 1849. Notice of the former existence of small glaciers in County Kerry. J. geol. Soc. Dubl. 4, 151-154.

BENNER, I.M. 1972. Cirque Glaciation in the Slieve Mish and Stradbally Mountains. Unpubl. B.A. dissertation, University College Dublin.

BOWEN, D.Q. 1973. The Pleistocene Succession of the Irish Sea. Proc. geol. Assoc., 84, 249-272.

BRYANT, R.H. 1966. The 'pre-glacial' raised beach in south-west Ireland. Ir. Geogr. 5, 188-203.

BRYANT, R.H. and QUINN, 1979. Report of a short field meeting to south-west Ireland. Quat. Newsl. 28, 32-35.





CHARLESWORTH, J.K. 1928. The Glacial retreat from Central and Southern Ireland. Q. Jl. geol. Soc. Lond. 84, 293-342.

CUPPAGE, J. with thirteen others 1986. Archaeological Survey of the Dingle Peninsula : Surbhé Seandálaíochta Chorca Dhuibhne. Oidhreacht Chorca Dhuibhne, Ballyferriter, 462pp.

DEVOY, R.J. 1983. Late Quaternary shorelines in Ireland : an assessment of their implications for isostatic land movements and relative sea-level changes. In Smith, D.E. and Dawson, A.G. (eds) Shorelines and isostasy. Academic Press, London, 227-254.

FARRINGTON, A. 1947. Unglaciated areas in Southern Ireland. Ir. Geogr. 1, 89-97.

GUILCHER, A. and KING, C.A.M. 1961. Spits, tombolos and tidal marshes in Connemara and West Kerry, Ireland. Proc. R. Ir. Acad. 61B, 283-338.

HAMILTON, C.W. 1842. On certain appearances on the surface of rocks in the neighbourhood of Bantry Bay. This paper was read but not published, but see: J. geol. Soc. Dubl. 2, 10-13; 4, 186; 5, xii.

HORNE, R.R. 1974. The Lithostratigraphy of the Late Silurian to Early Carboniferous of the Dingle Peninsula, Co. Kerry. Geol. Surv. Ire. Bull. 1, 395-425.

HORNE, R.R. 1975. The association of alluvial fan, aeolian and fluviatile facies in the Caherbla group (Devonian), Dingle Peninsula, Ireland. J. Sedim. Petrol. 45, 535-540.

HORNE, R.R. and WARREN, W.P. in prep. The Silurian inlier at Caheracruttera, Co. Kerry.

JUKES, J.B. AND DU NOYER, G.V. 1863. Explanation of Sheets 160, 161, 171 and part of 172 and of the engraved section, Sheet No. 15, of the Geological Survey of Ireland, illustrating part of the County of Kerry. Mem. Geol. Surv. Ire. 57,pp.

KING, C.A.M. and GAGE, M. 1961. The extent of Glaciation in part of West Kerry. Ir. Geogr. 4, 203-208.

LEWIS, C.A. 1974. The Glaciations of the Dingle Peninsula, County Kerry. Scient. Proc. R. Dubl. Soc. 5A, 207-235.

LEWIS, C.A. 1979. Quaternary Glaciation in Ireland - a comment. Quat. Newsl. 29, 12-16.

MITCHELL, G.F. 1970. The Quaternary deposits between Fenit and Spa on the North Shore of Tralee Bay, Co. Kerry. Proc. R. Ir. Acad. 70B, 141-162.

MITCHELL, G.F. and STEPHENS, N. 1974. Is there evidence for a Holocene sea-level higher that of today on the coasts of Ireland? Coll. Int. CNRS. No. 219, 115-125.

MITCHELL, G.F., PENNY, L.F., SHOTTON, F.W. and WEST, R.G. 1973. A correlation of Quaternary deposits in the British Isles. Geol. Soc. Lond., Special Report No. 4, 99pp.

ORME, A.R., DAVIES, G.L. and SYNGE, F.M. 1964. The Physique of the South of Ireland. In Steers, J.A. (ed.) Field Studies in the British Isles. Nelson, London, 482-499.

PARKIN, J. 1976. Silurian rocks of the Bulls Head, Annascaul and Derrymore Glen inliers, Co. Kerry. Proc. R. Ir. Acad. 76B, 577-605.

PROUDFOOT, V.B. 1954. The Glaciation of the Dingle Peninsula. Ir. Geogr. 3, 36-39.

ROWAN, A.B. 1852. Limestone boulders of Corkaquiney, County Kerry. J. geol. Soc. Dubl. 5, 201-203.

TAYLOR, R.B., CARTER, R.W.G., FORBES, D.L. and ORFORD, J.D. 1986. Beach sedimentation in Ireland: contrasts and similarities with Atlantic Canada. Curr. Res. geol. Surv. Can. 86A, 55-64.

WARREN, W.P. 1979. The stratigraphic position and age of the Gortian Interglacial deposits. Geol. Surv. Ire. Bull. 2, 315-332.

WARREN, W.P. 1980. Ice movements in south-west Ireland: comments on the supposed Connachtian Glaciation. Quat. Newsl. 31, 12-18.

WARREN, W.P. 1981. Features indicative of prolonged and severe periglacial activity in Ireland, with particular reference to the south-west. Biul. Peryglac. 28, 241-248.

WARREN, W.P. 1985. Stratigraphy. In Edwards, K.J. and Warren, W.P. (eds) The Quaternary History of Ireland. Academic Press, London, 39-65.



WATSON, E. and WATSON, S. 1970. The Coastal Periglacial Slope Deposits of the Cotentin Peninsula. Trans. Inst. Br. Geogr. 49, 125-144.

WILSON, P. and CARTER, R.W.G., (eds) 1984. Northeast Co. Donegal and Northwest Co. Londonderry. IQUA field guide No. 7, Irish Asociation for Quaternary Studies.

WRIGHT, W.B. and MUFF, H.B. 1903. The pre-Glacial Raised Beach of the South Coast of Ireland. Scient. Proc. R. Dubl. Soc. 10, 250-324.

## IQUA FIELD GUIDES

1. **South Co. Down.** A.M. McCabe (ed.) (1978)

2. **Galtees Region.** F.M. Synge (ed.) (1979) - not in print.

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